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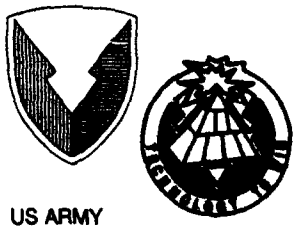

US ARMY
LABORATORY COMMAND
MATERIALS TECHNOLOGY LABORATORY

AMC MATERIALS TESTING TECHNOLOGY (MTT) PROGRAM

MTL TR 89-91

A SURVEY OF U.S. ARMY MATERIEL COMMAND TESTING NEEDS FOR MATERIALS AND IN-PROCESS TESTING

October 1989

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FINAL REPORT

U.S. ARMY MATERIALS TECHNOLOGY LABORATORY
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This document describes an in-depth survey of the United States Army Commodity Commands materials and in-process testing needs conducted as part of the Materials Testing Technology (MTT) Program. The purpose of the survey was to provide a planning matrix for the scheduling, prioritizing, and funding of projects to accommodate those needs. The results of the survey are presented in three different configurations: (1) Summary by Product Category, (2) Summary by Problem Area, and (3) Summary by Testing Technology. The survey received responses from all Army Major Subordinate Commands representing the various Army materiel categories. The survey has identified several testing situations and product categories which have common needs requiring solutions through test methodology. Keywords:

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1. INTRODUCTION

This document describes an in-depth survey of the United States Army Commodity Commands testing needs conducted in the latter portion of FY1988 and into the first part of FY1989. The Materials Testing Technology (MTT) Program Manager was tasked by the AMC Deputy Chief of Staff for Product Assurance and Test, Mr. S. J. Lorber, for conducting a survey of AMC's testing needs. The purpose of the survey was to provide a planning matrix for the scheduling prioritizing, and funding of projects to accommodate those needs. A similar survey was conducted by MTL for AMC in 1975. That survey filled a major need at the time, and provided an earlier planning matrix that led to the scheduling and successful conclusion of many critical testing needs projects. The scope of the current survey, its performance, results, conclusions, and recommendations are presented in this document.

The results of this Testing Needs Survey will be used as a guide for the funding of projects designed to meet the objective of the MTT Program. That program has as its objective the timely establishment of testing techniques, procedures, and prototype equipment to ensure efficient inspection methods for materiel/material procured or maintained by AMC. MTT projects also provide alternative test methods when existing methods are shown to involve hazardous or polluting materials and procedures. These projects support those testing needs that have not been solved during normal program/project/product development or that have arisen from legislated mandates. These efforts are critical to commodity products and performance.

Potential MTT projects are solicited from all of the AMC arsenals, depots, proving grounds, installations, etc., once each year. Problem submissions are also requested for those situations where the submitter either does not have the capability to perform the task or does not know of a potential solution. All project/problem submissions are reviewed by the MTT Program Manager to establish whether MTT criteria have been met before further technical and budgetary consideration is given. The submissions are categorized into four testing technology groups: mechanical, chemical, nondestructive, and electronics/software testing. The testing needs survey has also been organized to reflect this grouping.

Brief descriptions of seven previously funded and completed MTT projects have been included in Appendix A to show the types of projects that have been funded and their implementation histories. Additional information regarding the MTT Program and the Testing Needs Survey may be obtained by writing the U.S. Army Material Technology Laboratory, Attention: SLCMT-TM, Mr. W. Roy, Watertown, Massachusetts 02172-0001. Points of Contact are also listed in Appendix B for the Major Subordinate Commands (MSCs) represented in the various testing needs identified in this survey.

2. SURVEY BACKGROUND INFORMATION

A series of directives from AMCQA called for the initiation of a survey of AMC-wide testing needs related to Army materiel items in the inventory and in development. Survey letters were mailed on 19 April 1988 to the MSCs describing what the survey intended to accomplish, probable sources of testing needs throughout the material life cycle, and categories of information. Copies of the AMC and MTL correspondence regarding the survey are included in Appendix B for reference.

2.1 Scope of the Materials Testing Needs Survey

The Testing Needs Survey was carried out to identify and describe material testing needs throughout all phases of the life cycle for all systems, items, and components in or scheduled for the Army inventory. In general, testing needs may be identified in the production, in-service, overhaul and maintenance, and storage phases of a materiel life cycle. An emphasis was placed on those needs, current and anticipated, resulting from the planned increased use of emerging materials such as ceramics, composites, polymers, etc., in notional systems. Also, attention was given to requirements to evaluate the remaining life of components which are scheduled for routine replacement or evaluation during maintenance or rebuilding operations. Those testing needs applicable to system evaluations were not considered part of this survey's focus.

The production phase may include the monitoring and evaluation of quality parameters which affect production efficiency and end-product quality and reliability. Typically, on-line inspection and process control and feedback techniques are needed to maintain quality production and minimize lost material and rework time.

The in-service life cycle phase may include testing methods to monitor in-situ the performance or condition of a component or end-item. Critical component materials may need to be evaluated on a continuous basis during actual use to monitor stress states or other parameters which may indicate unacceptable performance. A component's condition may also be evaluated indirectly by monitoring real-time performance characteristics; for example, bearing noise may indicate deteriorating materials, or gun tube blow-by may indicate excessive wear.

In the overhaul and maintenance phase, a very wide variety of testing methodologies are employed. Extensive measures are needed at this point in the life cycle to avoid catastrophic failures that result from faulty workmanship, excessive wear, fatigue, or simply aged materials.

Finally, many materials in the Army inventory require storage for later use and thus surveillance in the storage life cycle phase. Inspection methods are used to monitor propellants and explosive materials whose performance may deteriorate with time in storage. Adhesives, paints and coatings, cloth and elastomer materials, among many other materials, are all subject to degradation with time.

The materials testing needs described in the above sections are by no means exclusive; many specialized testing needs can be found in all Army materiel categories. The examples given here serve only to categorize the type of testing which might be considered in different phases of the material life cycle.

2.2 Survey Structure and Performance

In response to the requirements of this task, a series of on-site reviews were conducted at AMC Major Subordinate Commands (MSCs) during the survey performance period. All MSCs were requested to provide in-depth briefings on each material testing need identified within or associated with their Command. Each Command was requested to assure the representation and

participation at these reviews of Program/Project Managers involved in materials-related developments associated with their Command.

The MTT Testing Needs Survey Team consisted of an MTT Program liaison from MTL and a representative of the Nondestructive Testing Information Analysis Center (NTIAC), an outside contractor employed to assist in administering the survey. The information requested of all MSCs can best be summarized in the form of the following series of questions:

(a) Where in the material life cycle is the testing need?

(b) Is the need associated with a system (program/project managed) or does it have broad potential for application to many systems?

(c) Is the need specific to a material or process?

(d) What are the current requirements and/or QA procedures?

(e) What are the potential benefits? (Return on Investment, Reliability, Availability, Maintainability, etc.)

(f) Is the need immediate or anticipated?

(g) Is there a proposed solution?

(h) What is the testing technology? (Mechanical, Chemical, Nondestructive Testing (NDT), Electronics/Software, or combination?)

These questions are not meant to be exclusive; they serve only to indicate the types of questions that were used to help in identifying testing needs in context. A one-page Information Summary Form was provided to all participants to assist in specifying the testing needs in a complete and concise manner. Some examples of the Summary Form can be found in Appendix C.3. Additionally, an information categories listing was provided to serve as a guideline for the participants and is included in the letter documentation of Appendix B.

The testing needs survey was initiated during the latter portion of FY1988 and the last command was surveyed during the first part of FY1989. Fourteen sites were visited during the survey; however, testing needs information was requested from all AMC MSCs. In many instances, additional materials were provided during the briefings and later in the form of more detailed documents received by the MTL/MTT liaison. All of the major commodity commands were represented at one or more of the site visits. Table 1 lists the survey sites visited and the MSC representation.

TABLE 1

SURVEY SITE VISITATIONS

LOCATION	INSTALLATION	COMMAND REPRESENTED
Dover, NJ	Picatinny Arsenal Armament Research, Development and Engineering Center	AMCCOM ARDEC
Edgewood, MD	Chemical Research, Development and Engineering Center (Edgewood)	AMCCOM (CRDEC)
Watervliet, NY	Watervliet Arsenal	AMCCOM
Ft. Monmouth, NJ	CECOM Headquarters Electronic Testing and Devices Labs	CECOM LABCOM/ETDL
Chambersburg, PA	DESCOM Headquarters Letterkenny Army Depot	DESCOM DESCOM/LTRK
Corpus Christi, TX	Corpus Christi Army Depot	DESCOM/CCAD, AVSCOM
Texarkana, TX	Red River Army Depot	DESCOM/RRAD
Adelphi, MD	LABCOM Headquarters Harry Diamond Labs	LABCOM LABCOM/HDL
Watertown, MA	Materials Technology Labs	LABCOM/MTL
Huntsville, AL	Redstone Arsenal	MICOM
Warren, MI	Tank Automotive Command	TACOM
Aberdeen, MD	Aberdeen Proving Grounds	TECOM/APG
Natick, MA	Natick Research, Development and Engineering Center (NRDEC)	TROSCOM

3. MATERIALS AND IN-PROCESS TESTING NEEDS SURVEY RESULTS

Over 170 individual responses were received from those participating in the survey. In general, the survey responses were brief and informal. A few responses were deemed to be specifically system-oriented and were not considered further in the survey. Some responses were also considered administrative in nature and were also not considered further. To assist in the analysis of the survey data, the information provided by each respondent (Information Summary Forms and briefing presentations) was entered into a computer database and given a maximum of eight keywords which concisely described the submitted testing need. More specific information regarding the individual entries and the database format is given in Appendices C, D, and E.

3.1 Survey Reporting Format

The Testing Needs Survey results have been organized into three different configurations: (1) Summary by Product Category, (2) Summary by Problem Areas, and (3) Summary by Testing Technology. **Each of the summary configurations encompasses all of the responses in the survey and represents only a different perspective on the same data.** In this manner, specific products and testing needs have been grouped to identify frequently occurring needs and/or needs common across multiple Army commodities.

The **Product Category Summary** focuses on testing needs related to specific Army products. It has been subdivided into groupings by Ammunition and Weapons, Tracked Combat and Tactical Support Vehicles, Aircraft and their components, Missiles and their components, Personnel Support Equipment and items, and Electronic Equipment and Software requirements.

The **Problem Areas Summary** focuses on the major problem groups identified in the survey. This summary has been subdivided into the following general problem areas:

(1) Materials Characterization and Properties
(2) Automated Testing and In-Process Control
(3) Diagnostic Testing and Assessment
(4) Bonding and Adhesive Joining Technology
(5) Materials Durability and Structural Integrity
(6) Nuclear, Biological and Chemical Testing Problems
(7) Sensors, Optics and Measurement Technology
(8) Energetics and Munitions Testing
(9) Other Army Testing Problems

The **Summary by Testing Technology** identifies the more common methods used in the evaluation of materials and components. This summary has been subdivided into the categories of Mechanical Testing, Chemical Testing, Nondestructive Testing, and Electronics and Software Testing. Other identified testing technologies are grouped in a separate category.

3.2 Testing Needs Summary by Product Categories

Of the 174 survey responses evaluated, 69 (40%) were categorized as being related to ammunition and weapons; 47 (27%) were related to vehicles; 33 (19%) were related to aircraft equipment and products; 9 (5%) were related to missiles elements and products; 56 (32%) were related to personnel and support equipment; and 22 (13%) were related to electronic materials, equipment, and software. Since some of the submissions had direct relation to multiple categories, these numbers total more than the 174 individual survey responses. **The following sections contain**

descriptions which highlight the most prominent testing needs in each of these categories. Table 2 summarizes the testing needs identified by product category; Figure 1 shows the percentage of survey responses for each product category. Refer to Appendices C, D, and E for a complete listing of the individual submitted testing needs.

3.2.1 Ammunition and Weapons

This Army product category considers those products which are best described by the following terms: explosives, pyrotechnics, and propellants; munition body, fuzes, bands, seals, etc.; artillery tubes, rifle barrels, breech components, etc.; fire control mechanisms; ballistic phenomena and simulation; and other munitions, devices, or functions which are most directly related to army ammunitions and weapons.

The ammunition and weapons category of Army products commanded the most attention of the surveyed responses. NDE and inspection techniques related to gun tubes is the area most in need of testing techniques. Emphasis was placed on more automated inspection and evaluation methods and systems. The testing needs are directed at gun tube materials and at coating technology for corrosion and wear resistance. Plating processes used in gun tubes are in need of control techniques for real-time quality control. Testing methods are needed for both chemical analysis and plating analysis during the plating process. Field inspection techniques and equipment are also needed for these weapons. Testing needs for composite materials to be used in planned systems are also drawing attention from different perspectives. More standardized mechanical tests of composite materials to determine properties are needed. After implementing composites on weapons systems, standardized nondestructive evaluation (NDE) methods are sought. The development of ceramics for gun tubes and weapons in general has prompted a need for testing methods that can be applied for simple and reliable material evaluation.

Testing methods to evaluate the condition of stored munitions and propellants could have significant impact on the large stockpiles in the Army inventory. Vision systems and inspection technology could also have an impact on the current tedious methods of boroscopic gun tube inspections. In general, vision technology and intelligent systems could remove the subjective judgement involved in many types of visual inspections and evaluations, color determination for chemical agent detection, effectiveness testing of obscurants, corrosion measurement in gun tubes, and many other applications.

3.2.2 Vehicles, Tracked Combat and Tactical Support

This Army product category considers those products which are best described by the following terms: tanks; armored personnel carriers; tracked artillery; wheeled vehicles; vehicle armor; treads; road wheels; engines, transmissions, gears, bearings, brakes, etc.; other vehicle items or functions which are most directly related to these types of Army vehicles.

The call for testing needs related to Tracked Combat and Tactical Support Vehicles ranked third among the surveyed responses. Automated inspection techniques and equipment were commonly referenced in relation to engines and engine components, particularly at the depot/maintenance level. The testing needs were those applicable to bearings, transmissions, engine dimensioning, oils and lubricants, structural welds and repairs, and adhesive bonds. Methods of monitoring and accurately determining wear on bearing surfaces and gear mechanisms are needed for vehicles, aircraft, and system control mechanisms. In the maintenance phase, accurate, automated dimensioning methods and equipment are needed for the many time-consuming tolerance checks necessary during engine rebuilding. Reliable testing methods for on-line lubricant analysis could serve to extend the service life of many components by indicating appropriate service intervals before excessive wear damages the part.

TABLE 2

SUMMARY OF TESTING NEEDS BY PRODUCT CATEGORY

ARMY PRODUCT CATEGORY	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Ammunition and Weapons	Gun Tubes - Automated inspection methods and systems Modern manufacturing methods and control techniques Plating process control and evaluation techniques Corrosion and wear resistant materials and inspection techniques Field inspection techniques and equipment NDE methods for ceramic materials Stored Munitions & Propellants - NDE methods to determine propellant quality Rapid inspection methods for stored munitions
Vehicles, Tracked Combat & Tactical Support	Engines & Components - Automated inspection methods Testing methods for bearings, gears and mechanisms, transmissions, oils and lubricants Engine dimensional testing, depot/maintenance Structures - Materials testing methods for metals and emerging materials, i.e., composites, ceramics, etc. Welding Technology - Weld process control techniques Automated inspection techniques Adhesive Bonding - NDE methods for bond integrity assessment Accurate mechanical bond strength test methods
Aircraft	Engines - Wear evaluation and monitoring Hydrogen embrittlement of engine components Corrosion detection and control Structures - Corrosion detection, control, and prevention Plating evaluation, plating process control Composite materials evaluation methods Adhesive Bonding - NDE methods for bond integrity and strength
Missiles	Rocket Motor Casings and Propellants - NDE methods for casing inspection NDE methods for propellant quality and stability Electronic Subsystems & Elements - Mechanical testing of electronic subassemblies, vibrations testing, shock testing, reliability Testing technology for semiconductor materials and microelectronic devices

TABLE 2 (Continued)

SUMMARY OF TESTING NEEDS BY PRODUCT CATEGORY

ARMY PRODUCT CATEGORY	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Personnel and Support Equipment	Clothing, Suits, Masks, Fabrics, Strapping - NDE methods for aging due to exposure Environmental durability testing methods Effectiveness testing against NBC agents NBC Agents - Rapid, automated detection techniques for materials testing and evaluation Rapid detection techniques and instruments for field situations Shelters - Testing and evaluation methods for composites Rations and Food Items - Evaluation methods for food storage containers Testing methods for packaging and seal integrity Food quality and storage stability testing
Electronic Equipment and Software	Microelectronics/Sensor Technology - Semiconductor wafer and device evaluation methods Testing methods to improve yield Life estimation techniques Assembly Technology - Circuit board evaluation technology Solder joint NDE methods Reliability testing methods Software - Model verification techniques Process and manufacturing control software Evaluation of battlefield networking Testing of artificial intelligence implementations

U.S. ARMY TESTING NEEDS SURVEY
PROBLEM SUBMISSIONS BY PRODUCT CATEGORY

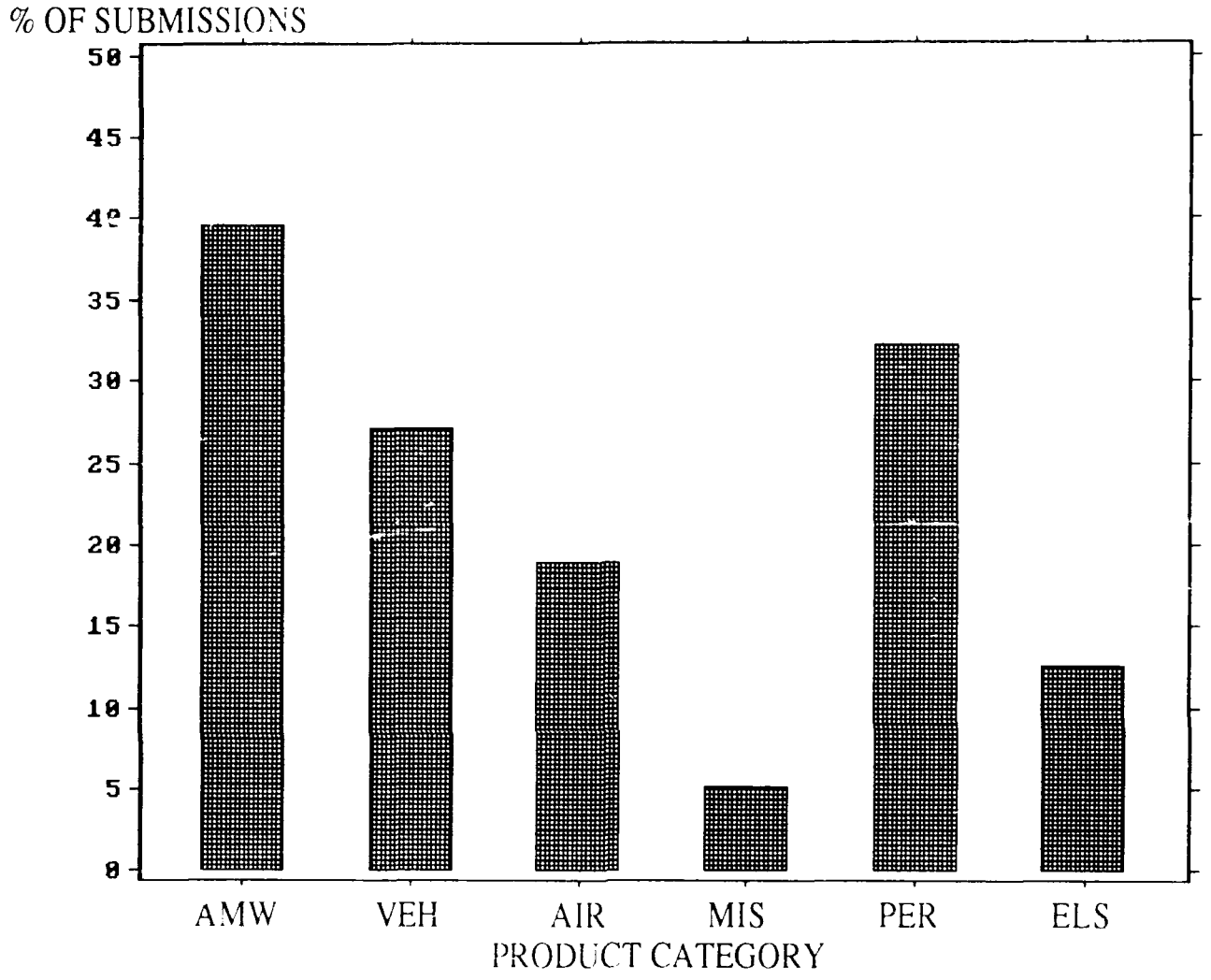


Figure 1. This chart shows the percentages of the Testing Needs Survey submissions organized by Army product categories. Since some submissions were applicable to multiple categories, total percentages exceed 100%.

Legend:
- AMW - Ammunition and Weapons
- VEH - Vehicles, Tracked Combat and Tactical Support
- AIR - Aircraft, Components and Related Equipment
- MIS - Missiles, Components and Related Equipment
- PER - Personnel Items and Support Equipment
- ELS - Electronic Equipment and Software Support

Engine materials were also frequently referenced. Most of the engine materials testing needs were applicable to the existing materials (metals in general); however, the emergence of ceramic engine materials will require testing methodologies which have yet to mature and will need significant development.

Also, the needs for reliable and field-applicable weld inspection methods are still present despite the many years of development in industry. Automated methods of inspecting welded structures and repairs are needed in order to remove the uncertainty of visual inspection.

More frequently now, adhesive bonds are taking the place of welded or fastened joints. In spite of recent focus in this area, bond evaluation techniques are still in development and in high demand for the manufacturing and maintenance operations.

New armor materials and technologies are in constant development. Again, ceramics and composites are the materials most in need of new evaluation methods.

3.2.3 Aircraft

This Army product category considers those products which are best described by the following terms: helicopters; light aircraft; remotely piloted aircraft; rotor blades, materials, panels, etc.; aircraft engines and components, including transmissions, gears, bearings, etc.; aircraft structures and materials; other components or functions which are most directly related to Army aircraft.

The testing needs for Army aircraft and related equipment can be described by the following keywords: engines, corrosion, composites, and adhesives. Testing methods related to aircraft engines are needed for the evaluation of bearings, oils and lubricants, grinding burn damage to engine materials, and material degradation resulting from hydrogen embrittlement. The early detection of corrosion damage to aircraft structures and components remains to be achieved despite efforts throughout the industry. Army needs in this area parallel the needs for corrosion testing in the aircraft industry in general.

Related to the corrosion problem is the evaluation of platings on aircraft components (and many other components) which requires the development of easily applicable testing techniques. Control of plating processes, thickness determination, and plating adhesion evaluation are clearly expressed needs for Army materiel.

Developments in the use of composite materials have also found their way into many Army aircraft structures. The assessment of damage to composite materials is an area in need of a significant amount of further development. The variety of composite materials and their applications make common assessment techniques difficult to achieve. Nonetheless, standardized and reliable testing methods are needed for use Army-wide for composite materials acceptance and subsequent damage assessment and maintenance.

Along with composite materials, adhesives are used with growing frequency in Army aircraft and systems. Their weight and strength advantages (among others) are tempered by the difficulty of inspecting or evaluating the condition of the joints. These difficulties arise both during manufacturing and during service maintenance. The use of composite materials and adhesive joining in critical applications, such as rotor blades and control surfaces, highlight the need for accurate and reliable testing methods for Army aircraft.

3.2.4 Missiles

This Army product category considers those products which are best described by the following terms: missiles and missile system components; casings, liners, and missile propellants; missile guidance and target discrimination equipment; missile sensors and electronic elements; other materials, devices, or functions which are most directly related to missiles and their systems.

The Army missiles product category produced the least number of responses from the participating commands. This should not reflect less urgent needs. Many of the testing needs for missiles are the same needs expressed in other product categories. Specific to the missiles category are the needs for rocket motor casing and propellant inspection methods and vibration testing methods for integrated electronics. The use of solid propellants in modern rockets requires inspection methods capable of detecting propellant/casing delaminations and propellant density variations. Damage to rocket motors during storage and shipping is often not detected in external visual inspection. Yet, the undetected condition poses a serious hazard to operating personnel and equipment.

Missiles also incorporate integrated electronics for guidance and control, and target acquisition, identification, and tracking. A need exists for vibration testing for these electronic elements. The physical environment to which missiles are exposed during operation places severe requirements on the reliability of the various elements. Many electronics testing needs were also expressed in relation to their applications to missile systems. Sensor technology, electronic system reliability, and artificial intelligence testing methodology needs are described in the electronics product category in Paragraph 3.2.6.

3.2.5 Personnel and Support Equipment

This Army product category considers those products which are best described by the following terms: personnel items, clothing, fabrics, helmets and body armor; masking devices and personnel protection equipment [nuclear-biological-chemical (NBC)]; food, rations, food storage and preparation equipment and facilities; construction equipment and materials, bridging, etc.; other materials, devices, or functions which are most directly related to personnel and support equipment.

Personnel items and support equipment testing needs ranked second in the surveyed responses. Most of the attention in this category was focused on protective clothing items. Testing methods are needed to evaluate the effectiveness of materials used in suits, masks, and gloves designed to protect personnel in the NBC warfare environment. Current laboratory methods for testing against various threats are outdated and do not take advantage of current technology. While these testing needs are specialized, gains can be made in testing sensitivity and efficiency. Most of these testing needs involve the determination of agent absorption, permeation, and penetration of NBC materials. Rapid detection and identification of NBC agents in the battlefield are also needed to assist personnel in selecting the proper defensive response. Again, some of the current methods involve subjective human interpretation of the response (color change) of chemically sensitive papers and materials. A more rapid, automated testing method, material, or detector is needed. Decontamination testing methods are also needed to determine the effectiveness of the neutralizing actions. Paint coatings, fabrics, and other materials must be tested to determine the extent of absorption of NBC agents and any post-decontamination residue. In relation to the testing of materials against NBC agents, safe and effective agent simulator materials are needed to reduce both the hazards involved and the resulting waste products.

Other personnel/support items receiving attention in the survey include shelters, parachute/strapping materials, and food packaging technology. The light weight and strength advantages of composite materials are being applied to shelters; testing and inspection methods are needed for maintenance of these structures. Parachute and strapping materials degrade with time, exposure, and use. Accurate testing methods for these materials are needed for periodic evaluation of their integrity. Rations and food items are stored for long periods and testing methods are needed to effectively evaluate the condition of the packaging and the integrity of the seal.

3.2.6 Electronics/Software Equipment

This Army product category considers those products which are best described by the following terms: command, communication, control, and intelligence (CCCI) electronic equipment; battlefield networking and decision support equipment and software; microwave and millimeter wave technology; semiconductor and sensor technology; other materials, devices, or functions which are most directly related to electronic equipment and software requirements.

Electronic devices, equipment, and software are common now in nearly every Army product category. The problems in need of testing methods can be generally grouped into semiconductor/sensor technology, assembly technology, reliability analysis, artificial intelligence and programming. The most basic needs in this category involve testing methods to determine the quality of semiconductor sensor and microelectronics materials. Because of the exotic nature of these materials, production efficiency, product yield, and component reliability are low.

The emergence of microwave and millimeter wave technology has presented new problems for equipment designs and their evaluation. The assembly of electronic circuits and devices requires many interconnections at the semiconductor packaging stage, at the circuit board level, and at the system level. Solder joint integrity is a common source of reliability problems, and efficient testing methods are needed to evaluate the many joints present at all levels of assembly. This tedious effort can be aided by the use of automated inspection systems for electronic assemblies. Efforts in improving solder joint integrity can go a long way in improving the reliability concerns in military systems and subsystem elements. However, electronic component reliability (semiconductors and other components) remains to challenge testing methodologies.

Efforts to predict remaining life and failure of electronic elements are impeded by the lack of testing methods to quantify characteristics which are indicative of component life expectancy. Modern computer technology brings with it many possibilities for automated applications, expert systems, and the implementation of artificial intelligence. This technology can be exploited to the benefit of all Army product categories; testing technology in general can be refined and made more reliable through the use of automated systems.

Many testing needs for well defined processes in manufacturing and maintenance can be achieved through the use of expert systems for process control and decision support. Expert systems and artificial intelligence can also be implemented for testing target acquisition and pattern recognition systems used in many Army applications.

3.3 Testing Needs Summary by Problem Areas

The survey responses were also organized according to the outstanding problem areas identified in the submitted testing needs. The problem areas are identified as follows:

(1) Materials Characterization and Properties
(2) Automated Testing and In-Process Control
(3) Diagnostic Testing and Assessment
(4) Bonding and Adhesive Technology
(5) Materials Durability and Structural Integrity
(6) Nuclear, Biological, and Chemical Test Methodology
(7) Sensors, Optics, and Measurement Technology
(8) Energetics and Munitions Tests
(9) Other Army Testing Problems

Since most of the testing needs fall into multiple problem areas, the total of the occurrences in all of the categories exceeds the number of actual submissions. **The following sections contain descriptions which highlight the most prominent testing needs in each of the categories.** Table 3 summarizes the testing needs identified by problem area; Figure 2 shows the percentage of survey responses for each problem area. Refer to the Appendices for individual listings of submitted testing needs.

3.3.1 Materials Characterization and Properties

Testing needs that addressed the determination of the physical properties of specific materials were grouped together in this category, which includes 47% of the survey responses. Typically, these testing needs involve the quantification of various material properties such as yield strength, elasticity, residual stress and dynamic stress measurement. The chemical properties and compatibility of materials are also considered in this category.

Composite materials were most frequently mentioned in the survey responses. The growing use of composites in many Army systems brings with it testing needs specific to each of the applications. Conventional methods for testing the mechanical properties of materials are often not applicable to composites. Special setups and equipment are needed to accurately measure composite characteristics without the assumptions routinely applied in metals testing. Problems in composite testing are compounded by the variety of the materials. Metal matrix, graphite epoxy, and kevlar wound composite, among other composite materials, have been applied to numerous Army commodities in development or already in the inventory. The testing needs expressed in the survey call for accurate composite materials testing methods, standardization of test methods and procedures, and a clear definition of the limitations of the techniques. Acceptance standards are also needed for new composite materials and components which will be incorporated into Army systems. Issues of damage assessment and the maintenance and repair of these materials are also of concern to the Army commodity commands.

Testing methods for ceramic materials also received significant attention in the survey responses. These materials are in development for armor applications, gun tubes, engine components, and other applications requiring high strength at elevated temperatures. Testing methods for ceramics are in evolutionary development; as such, serious direction is needed to apply proper test methodology to these new materials. As an example, molded ceramics require a carefully controlled curing cycle. Methods are needed to monitor the curing cycle to assure proper treatment which yields materials of consistent properties. As with composite materials, mechanical tests specific to ceramics are needed for the accurate assessment of material properties.

Metals and other conventional materials continue to drive the majority of the commodity applications. More frequently, efforts are being made to predict the lifetime and/or the remaining life of critical components; methods are needed to sense or measure parameters which may be indicative of material life. A common approach to prolonging the life of metals is to protect them with the use of platings. This chemical process is in need of monitoring and

TABLE 3

SUMMARY OF TESTING NEEDS BY PROBLEM AREAS

TESTING PROBLEM AREA	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Materials Characterization and Properties	Composite Materials - Testing methods, standards and procedures Damage assessment techniques Repair and maintenance guidelines for composites NDE methods Ceramic Materials - Testing methods, standards and procedures Mechanical testing techniques Cure monitoring and control Armor and AntiArmor Materials Testing Glass and Plastic Panel Testing Methods Elastomers Materials Development and Testing Modeling Techniques - Software for material and design evaluation
Automated Testing and In-Process Control	Test Automation - Manufacturing tests, quality/tolerance checks Dimensioning in maintenance operations Test data analysis and decision support Gun tube inspections Circuit board inspections and evaluations Weld inspections, etc. Process Control - Gun tube manufacturing and machining Plating processes in gun tubes, engine components, aircraft parts and structures Welding processes in manufacturing and maintenance Sensor technology for in-process control
Diagnostic Testing and Assessment	Nondestructive Evaluation Methods - Composite materials manufacturing defects, delaminations, improper lay-up, inadequate curing; Damage detection and assessment Adhesive bond evaluation, strength and integrity Ceramic materials, cure testing, detection of manufacturing defects Inspection of platings and detection of corrosion Sensors for quality control during manufacturing Semiconductor Materials - Quality assessment of exotic semiconductor and sensor materials to improve yield Electronic Circuit Assemblies - Inspection methods for solder joints and multi-layered assemblies Life estimation tests and techniques

TABLE 3 (Continued)

SUMMARY OF TESTING NEEDS BY PROBLEM AREAS

TESTING PROBLEM AREA	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Bonding and Adhesive Technology	Bond Strength Determination - Accurate mechanical testing methods and NDE methods Welding Technology - Automated welding and inspection techniques Soldering Technology - Rapid inspection techniques Plating Adhesion - Inspection methods to determine plating quality In-process testing of platings
Materials Durability and Structural Integrity	Corrosion Detection and Assessment - NDE methods for gun tubes, aircraft structures and components, and engines and components Wear Determination - Bearings, engine components, gears and mechanisms Gun tubes and gun tube platings Oil and lubricant quality monitoring Solder Joint Mechanical Integrity - Vibration testing and high-g event simulation/tests Elastomer Materials Durability Testing Fabric, Tenting, and Strapping - Mechanical durability testing Environmental susceptibility testing
Nuclear, Biological, and Chemical Testing	Rapid Agent Detection Techniques and Equipment - Modern penetrability techniques and equipment Automated ensemble/mask testing Field agent detection instruments Chemical Agent Effects on Materials - Effects on paints, coatings, sealants, elastomer, composites, and other commodity materials Hazardous Waste Control - Use of accurate simulants to reduce waste Waste storage monitoring techniques
Sensors, Optics, and Measurement Technology	Sensors for Automated Testing and In-Process Control - Weld process monitoring and control techniques Plating process monitoring and control techniques Automated nondestructive evaluation Vision Systems for Critical Inspections - Expert systems, artificial intelligence Measurement Technology - Laser applications in gun tube manufacturing Remote sensing of motion, vibration, and velocity in ballistic testing Non-contact electronic device interrogation

TABLE 3 (Continued)

SUMMARY OF TESTING NEEDS BY PROBLEM AREAS

TESTING PROBLEM AREA	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Energetics and Munitions Testing	Rocket Motor Casing and Propellant Testing - NDE methods for rocket motor inspections Propellant quality testing methods Munitions Testing - Neutral test bed for mortar/life fire testing Munitions Stockpiles Testing - Energetic materials stability test techniques for stockpiled munitions
Other Army Testing Problems	Software Modeling and Simulation - Solder joint modeling Ballistic events, high-g events Plasticity theory, armor & antiarmor materials Process control software & simulation Artificial intelligence, neural networks Test interpretation and decision support software Software reliability testing methods Testing Procedures and Standards - Standardized tests and procedures for composites and emerging materials Hazardous Waste Monitoring and Reduction

U.S. ARMY TESTING NEEDS SURVEY SUBMISSIONS BY PROBLEM AREAS

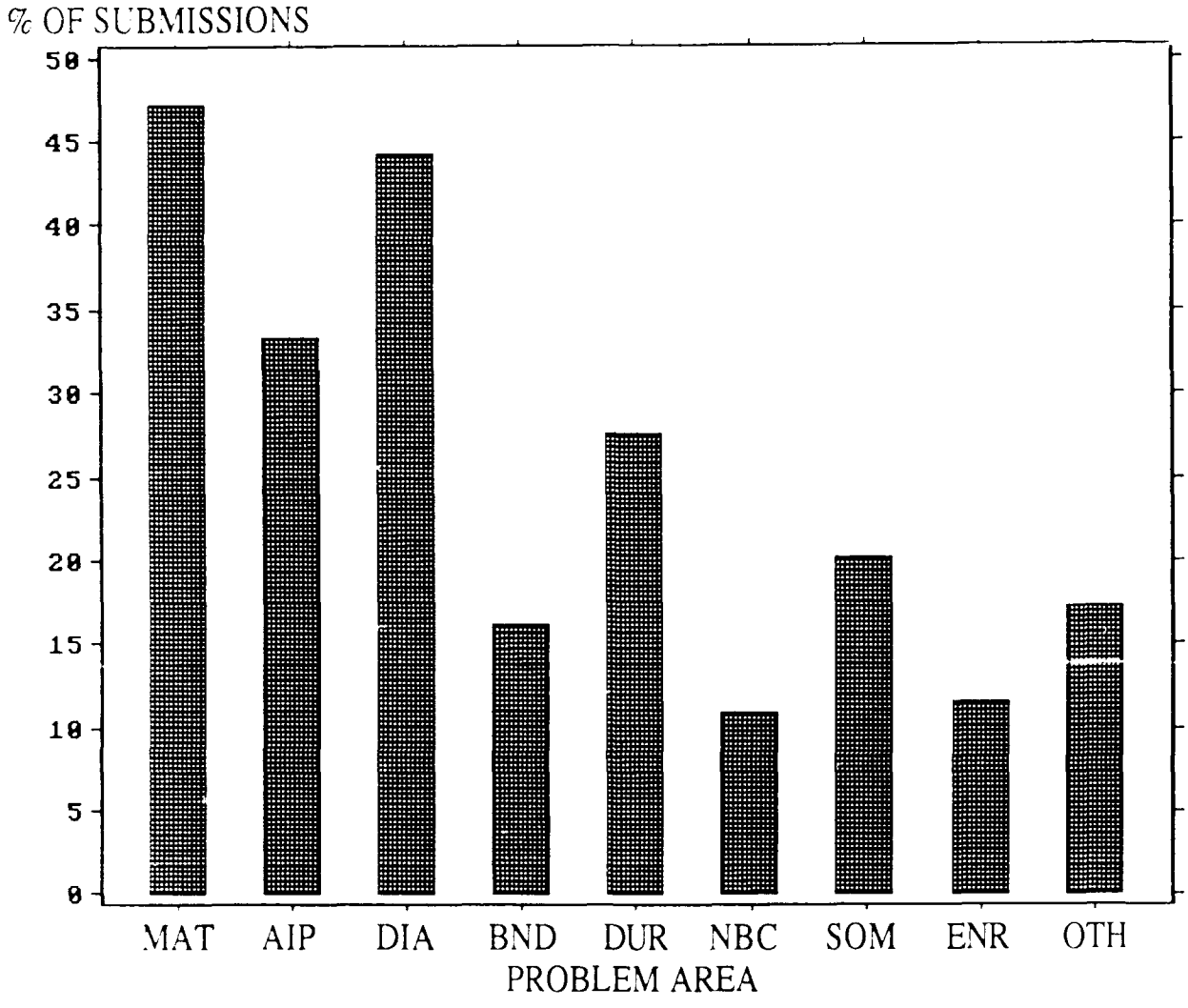


Figure 2. This chart shows the percentages of the Testing Needs Survey submissions organized by the major identified problem areas. Since some submissions were applicable to multiple problem areas, total percentages exceed 100%.

Legend:
MAT - Materials Characterization and Properties
AIP - Automated Testing and In-Process Control
DIA - Diagnostic Testing and Assessment
BND - Bonding and Adhesive Joining Technology
DUR - Materials Durability and Structural Integrity
NBC - Nuclear, Biological, and Chemical Testing
SOM - Sensors, Optics, and Measurement Technology
ENR - Energetics and Munitions Testing
OTH - Other Army Testing Problem Areas

control techniques which can result in more consistent plating quality. These plating test needs extend across a wide variety of Army commodities: gun tubes, engine components, aircraft parts, and many others. Testing techniques are needed to evaluate plating integrity at the maintenance level as well. Parts are protected from excessive wear with the common use of lubricants and oils; testing and evaluation techniques for these compounds were also frequently mentioned in the surveyed responses.

Computer modeling and simulation have been used more frequently to assist designers in specifying efficient designs without compromising performance characteristics. The estimations provided by computer models give information for materials and dimensional selections. This results in more accurate preliminary designs, reducing costly testing and iterative design modifications. Testing methods are needed to verify the validity and accuracy of these computer modeling techniques. While this testing need may be appropriate to the electronics/software category, its impact on materials and designs is significant.

3.3.2 Automated Testing and In-Process Control

A wide variety of testing techniques and methodologies were offered as possible solutions to needs within the various Army commodity commands. However, two distinct generalized needs were apparent. First, automated testing, inspection, and/or evaluation was a common thread throughout many of the declared needs. Second, the implementation of process monitoring and control techniques was a frequently stated objective of many of the survey responses. This testing need category (33% of survey responses) focuses on automated test methodologies and the use of control techniques applicable to the evaluation of Army commodities at all phases of the materiel life cycle.

Many test techniques depend heavily on the skill and experience of the operator and may result in ambiguous and inconsistent results. In an effort to improve the repeatability of tests and the efficiency of the many testing processes, automated systems are being requested and implemented. The strongest need for this type of systematic testing approach is in the manufacturing and maintenance phases of the life cycle. Automated testing and evaluation were suggested in the survey responses for applications such as inspection of gun tubes, circuit board solder joints and assemblies, welds, and visual inspections. Automated testing should contribute to more consistent results, more efficient production, and an increased level of confidence in decisions based on the test results.

Related to automated testing methodology is the use of sensors and control mechanisms for manufacturing and maintenance processes. Many tasks on the manufacturing floor require processes that rely on accurately repeated conditions in order to produce consistently acceptable results. With a method to monitor critical parameters of the process, manufacturing efficiency can be significantly enhanced. This effort toward process control must begin with the sensor and the monitoring techniques for accurate control. An area of common need, mentioned previously, is the plating processes used for corrosion and wear control on many parts exposed to harsh environments. Currently, plating processes rely on established conditions used successfully in previous batch operations. A means to automatically monitor the deposited material would greatly improve the coating consistency.

The welding process could benefit from process control techniques. This operation obviously has many applications throughout the Army, in the production of combat systems and in their repair and maintenance. Active control of welding processes has been demonstrated using optical, infrared, acoustic, and other sensing techniques. Implementation of these techniques in Army operations could yield reductions in material loss and rework time, as well as improvements in product quality.

3.3.3 Diagnostic Testing and Assessment

The testing needs summarized in this category involve those which are directed at the determination of a material's existing condition relative to some previously established standard or known condition. This category is not limited to performance or problem analysis, but encompasses a broader definition to include inspection methodology and techniques. Diagnostic testing needs were indicated in nearly half (44%) of the survey responses.

Inspection methods and techniques for a wide variety of Army commodities were dominant in this category of the testing needs survey. Composite materials are in need of methods to detect subsurface defects such as delaminations, improper lay-up, voids, inadequate curing, and other problems. Since composites are used in a wide range of applications, the specific emphasis of the testing needs varies. Closely coupled with the use of composite materials, adhesive bond assessment has drawn significant attention because of needs to inspect and accurately evaluate the bond quality.

Although the testing of metals is a well developed technology, inspection methods are still needed for corrosion detection, plating and coating evaluation, hydrogen embrittlement assessment, and wear detection. Many of the existing methodologies or techniques are inadequate due to poor test accuracy and dated equipment and techniques.

As mentioned in the previous section, testing and inspection methodologies can benefit significantly with the development and application of automated and intelligent systems. Diagnostic systems for monitoring, inspection, and in-process control can improve test accuracy, reliability, and efficiency, resulting in the reduction of wasted materials and improved quality. This theme was clearly evident in many of the testing needs survey submissions.

Two diagnostic techniques that were briefly described in the survey could benefit the manufacturing of electronic components and subsystems. A magneto-optical mapper (MOM) employs a method by which the yield of exotic semiconductor sensor materials can be enhanced. With the MOM technique, semiconductor wafer material can be examined in an early stage of production, indicating the 'good' areas of the wafer, then allowing selective processing of those productive regions. This technique may have a significant impact on the yield of many exotic semiconductor materials used in Army sensor devices.

The second technique of significance is an inspection method called laminography. Electronic circuit assemblies have become more densely packed with the more frequent use of multi-layered printed circuit boards and surface mount technology. Laminography has the potential to quickly and selectively examine individual layers of a completed multi-layer circuit card assembly. This task is virtually impossible to perform using conventional methods once components have been installed on the board. The further development of this type of testing technique should favorably impact the production of electronic assemblies for Army systems and other government and industrial equipment.

Another goal of diagnostic testing and assessment is to provide useful information to determine the remaining life of materials and components. Methods are needed to indicate the remaining life by monitoring techniques and sensors. This need was specifically mentioned in the survey for electronic components and subassemblies.

3.3.4 Bonding and Adhesive Joining Technology

Material bonding technology in this category includes adhesive joining applications, soldering, welding technology, and the adhesion of plated or coated materials. In 16% of the survey submissions, bonding or joining problems were directly or indirectly associated with a testing need.

The problem of inspecting adhesively bonded joints has received recent specific focus throughout the Army. NDE techniques are in current development for a variety of applications, but most attention has been given to adhesively bonded composites and aircraft applications. The survey respondents reflected this emphasis with calls for NDE methods to evaluate composite structures used in aircraft, weapons systems, vehicles, missiles, and shelters. While some evaluation methods have been developed for specific applications, their use in other situations is hindered by limitations of the techniques and a lack of confidence in the test results. Similarly, mechanical testing techniques for adhesion strength do not accurately simulate loads that a joint encounters in real-life situations. Thus, throughout the Army there is a need to provide accurate and realistic guidelines, standards, and procedures for adhesive and composite testing and inspection which clearly define the limitations and specify where the techniques can be applied.

Welding technology may be considered another type of bonding problem within this category. A general need exists for monitoring and control techniques to allow the automation and in-process control of the welding. This technology must begin with the development of appropriate sensing techniques that would allow accurate control of a welding process. This may include optical, infrared, and other sensing schemes which could provide information that would indicate the ongoing condition of the weld and prevent out-of-tolerance conditions. The result would be more consistent quality welds, which may reduce the need for post-fabrication weld inspection. Where weld inspections are still required, automated systems and intelligent analysis of examination data is needed.

The adhesion of plating material to base material is also a bonding problem, which drew significant attention in the survey. Plating technology is used in applications such as gun tubes, engine components, airframe structures, bolts and fasteners, and many other applications throughout the Army. Platings are vital to protect materials from corrosion and enhance their wear resistance characteristics. Diagnostic methods are needed to determine if platings are properly applied and to determine the quality of adhesion to the underlying material. By developing in-process control techniques, the plating process can be made more reliable than the current batch processing and testing techniques.

Soldering is a bonding or joining process that relies on proper mechanical and electrical integrity. The survey responses indicated a need for solder joint inspection techniques which could be applied to densely populated circuit boards. Radiographic inspection methods coupled with appropriate image processing could be very useful in easing the tedious task of solder joint inspection. Methods to verify the electrical integrity of solder joints are also needed. With the large number of inspections that must be performed in this application, a systematic and automated inspection approach is needed.

3.3.5 Materials Durability and Structural Integrity

This category of Army testing problems is directed toward the problems associated with material integrity and mechanical qualities. Problems of wear, corrosion, mechanical strength and response are typical of those considered in the grouping. About 28% of the survey responses were related to problems of this nature.

Concerns for corrosion detection and damage assessment techniques were indicated frequently in the survey. NDE techniques for detecting corrosion in gun tubes, aircraft structures, and engine components are in high demand, particularly at the depot/maintenance level of product support. Methods are needed to quantify the extent of corrosion damage to assist in run/retire decisions. In gun tube applications, some corrosion inspection procedures involve subjective visual inspection to decide if parts should be refurbished or retired. Modern vision systems with appropriate image processing and image analysis intelligence are needed to facilitate these types of inspections.

Testing methods to determine wear were indicated in relation to engine components, bearings, platings, and gun tubes. Wear determination may be directly measured or can be inferred by monitoring operating parameters or other indicators. In engine applications, the accumulated deposits in oils and lubricants may be detected to indicate wear. Methods are also needed to monitor the quality of oils and lubricants to prevent viscosity breakdown, which results in excessive wear. Bearings and gears, with applications in engines, aircraft and vehicles, transmissions and drive mechanisms, are also in need of wear measurement techniques.

The mechanical durability of solder joints and circuit boards must be tested in order to ensure reliable operation in the field. While some testing procedures are in place, most techniques do not realistically test the components or subsystems. More accurate vibration testing is needed. This is particularly true of electronic elements included in missiles, which experience high-g loading.

Other materials that require durability testing are elastomers and fabrics. Elastomers used on tank track pads suffer from severe wear. New materials in development need testing methods which can realistically indicate how they would perform in field situations. Similarly, fabric materials used in uniforms, tenting, strapping, parachutes, etc., are also in need of accurate testing methods to determine the wear durability of the materials.

Finally, environmental testing methods and equipment are needed for many different Army commodities. While many Army procedures require some form of environmental testing, these requirements are waived in some instances due to a lack of equipment for a particular application. Materials mentioned in the survey responses as needing environmental testing methods were glass and plastic panels, nylon and other fabrics, and food and ration items.

3.3.6 Nuclear, Biological, Chemical Testing Problems

Although the Nuclear, Biological, and Chemical (NBC) testing problems represented a relatively small portion of the survey responses (11%), the testing needs in this category are rather specialized. Problems of agent detection and effectiveness of defensive materials and devices dominated the cited testing needs.

The testing methods for chemical and biological agents require accurate measurement and detection techniques because of the small quantities used and the potency of the agents. The equipment used in these tests is generally of dated technology. Tests are performed to determine agent penetrability against various materials and protective ensembles. Technological advancement is needed through automated testing in the laboratory and for protective item testing. Also, sensitive detection methods for minute quantities of agents are needed for field situations in order to provide the earliest possible warning of danger to allow quick troop response.

Testing is needed to determine the effects of chemical agents on various materials such as paints, coatings, elastomers, composites, adhesives and sealants, among many others. Materials that provide more effective resistance to agent penetration are needed. The decontamination process is very aggressive to the exposed materials. Testing methods are needed to

determine the effectiveness of the cleaning process and to measure its effects on the underlying materials.

Hazardous wastes are a byproduct of the necessary testing of chemical agent defensive measures and equipment. Testing methods are needed, however, which reduce the production of the dangerous byproducts. The use of less hazardous agent simulants has been suggested. This may be accomplished if the simulants can be shown to accurately mimic the true agent reactions and penetrability characteristics. Testing methods are also needed for the monitoring of hazardous waste storage sites in order to prevent environmental contamination.

3.3.7 Sensors, Optics, and Measurement Technology

This category of testing problems groups together those testing needs for sensing and measurement techniques and technologies. Problems related to this category were mentioned in 20% of the survey responses. Included here are the many sensing requirements for automated and in-process testing. Also included are those needs for the processing of visual inspection and measurement information.

Throughout the survey responses, a call for more efficient automated testing and in-process control techniques has been apparent. These needs imply a means of sensing parameters of the test or process that will provide accurate data for appropriate control functions and test decisions. The sensing needs for in-process control include weld process monitoring, plating process evaluation (both chemistry analysis and deposition measurement), and machining process control. The technologies applied in these situations vary greatly. However, the end result is to indicate the condition of an ongoing process in order to maintain a particular level of quality which results in a minimum amount of post-production rework or adjustment.

Commodity testing in general is a necessary but time-consuming process. Considering the current state of the art in automated, intelligent systems, significant improvements in test productivity and accuracy can be achieved by automating many commodity tests. This approach can be applied to materials testing (gun tube manufacturing, etc.), testing in many maintenance operations (engine overhaul, dimensioning, etc.), and electronic subsystems testing, among many others. Inspection processes using NDE techniques can also benefit from automated systems and data interpretation. The use of vision systems with image analysis capabilities can greatly improve tedious visual inspections, and can help to avoid skill-related test results and interpretation.

Identified in the survey were several Army testing situations which could benefit from the use of laser technology. Gun tube manufacturing can use laser technology for accurate straightness control and measurement. Laser methods can also be applied to ballistic and vibration testing. In ballistics, weapon, target, and projectile motions and velocity can be sensed by laser techniques. Laser technology has also been proposed as a means of sensing the performance of electronic devices in a non-contact manner, avoiding electronic noise, interference, and loading concerns.

3.3.8 Energetics and Munitions Testing

The testing of energetic materials and munitions received attention in 11% of the survey responses. This category encompasses propellant testing, rocket motor testing, munitions testing (live-fire testing), and those tests involving the energetic materials.

A testing method is needed to inspect rocket motor casings for internal damage to the solid propellant. This inspection is vital to the reliable performance of the missile after handling and transportation. Since damage to the propellant is often not apparent from exterior access, radiography and other NDE techniques have been suggested for the inspection. Munition

propellants are also in need of testing techniques. In propellant production, chemical analysis methods are needed to accurately indicate the quality of the process material and to provide active control of the process.

The results of munitions testing are affected by many factors in live-fire tests. In mortar testing, the base plate foundation can influence the test results. From one test site to the next, conditions vary and thus results vary. A testing method is needed to eliminate or at least account for this variation in order to reflect the munition's true performance. A base plate simulator or neutral test bed has been suggested in the survey.

With the large inventory of stockpiled munitions within the Army, a method is needed to quickly assess the quality of munitions after prolonged periods of storage. Many munition stockpiles are simply restricted from access because of the uncertainty of the stability of the active materials. With a safe nondestructive (perhaps chemical) technique, munition supplies can be tested to determine if they can still be used or assigned for proper disposition.

3.3.9 Other Army Testing Problems

About 17% of the survey responses were grouped together in this category of testing needs due to the small number of occurrences or because of commonality across diverse commodities. Predominant in this category are software modeling or simulation needs, which are as diverse as the Army commodities themselves.

Software modeling and simulation needs were cited for solder joint technology, ballistic behavior and high-g weapons and events, materials analysis (mechanical simulation, plasticity theory, armor and antiarmor, etc.), and process control modeling. Testing and evaluation methods were cited also for the software itself. Methods are needed to verify the validity of software models, and control and decision algorithms, and to ensure the reliability of program functioning. Testing of artificial intelligence schemes is needed for automated testing applications (including intelligent test interpretation) and for weapons systems employing target acquisition intelligence.

In several survey responses, needs for accurate test procedures and standards were mentioned. As material and testing technologies evolve and improve, changes in procedures and standards are slow to be implemented and documented. This delays or prevents the use of newer materials and testing techniques, despite apparent advantages. In particular, the use, testing, and repair/maintenance of composite materials is in need of definitive applications procedures and standards to guide Army personnel.

Finally, issues related to hazardous wastes were cited in numerous survey responses. Many Army manufacturing and testing processes use and generate waste materials that require very careful handling, storage, and final disposition. These processes can help to alleviate the growing problem by using materials that result in less hazardous wastes, both in quantity and in severity. Testing methods are needed to monitor the stockpiled wastes to prevent their release into the environment.

3.4 Testing Needs Summary by Testing Technology

The testing needs described in the survey responses usually covered multiple technology categories. However, an effort was made to categorize the needs into four classical groups. Mechanical testing was specified in 77 (44%) of the 174 responses. Chemical testing needs were called for in 47 (27%) survey submissions. The test technology category with the most survey responses was that of nondestructive testing; 102 (59%) responses indicated an NDT need. Electronics and software testing needs were indicated on 42 (24%) of the survey submissions. The

following subsections contain descriptions that highlight the most prominent testing needs in each of these categories. Table 4 summarizes the testing needs identified by test technology; Figure 3 shows the percentage of survey responses for each test technology. Refer to the appendices for a complete listing of the individual submitted testing needs.

3.4.1 Mechanical Testing

This category of testing needs includes those problems where the solution involves the scientific evaluation of materials/materiel in terms of those properties that stem from elastic and inelastic response to an applied load. Such properties include, but are not necessarily limited to toughness, hardness, tensile, shear, elongation, vibration, shock, etc.

The mechanical testing needs presented in the survey responses called for primarily classical testing methodology. The applications that were described focused on determining the physical characteristics of a variety of materials: metals, composites, ceramics, fabrics, polymers, and elastomers. A general need to modernize mechanical testing techniques and equipment was indicated in the survey. At the same time, the emergence of new materials has created a need for new approaches to some of the classical mechanical tests. In particular, composite materials in all their varieties require careful interpretation of mechanical test results since the effects of the different materials combine to give its overall characteristics. Because of these difficulties, a need for standardized test methods and procedures is apparent throughout the Army commodity commands. Similar testing needs are also in demand for ceramic materials.

Army weapons and systems are being designed for performance in increasingly harsh conditions. Testing methods are needed to evaluate the effects of vibration, spin and impact on electronic components, fuze mechanisms, smart munitions elements, engine components, and many other types of components used in Army commodities. Methods are needed to accurately measure and then simulate these types of mechanical environments. Ballistic and explosive events are commonly tested in costly live-fire tests. Through the use of modern testing techniques, much of this type of testing could be performed in a laboratory setting.

3.4.2 Chemical Testing

This category of test technology includes those problems where the solution involves the determination of the quality of materials by classical volumetric or gravimetric techniques as well as chromatographic, spectroscopic, thermal, radioanalytic and other methods of chemical analysis.

Testing needs involving some form of chemical techniques and/or analysis were not particularly numerous in the survey. However, the scope of the needs varied widely, ranging from food quality tests to chemical agent testing. Aircraft components, engine components, and gun tubes are particularly in need of reliable chemical analysis techniques to evaluate the integrity of the platings applied on many parts. The protection provided by platings is many times compromised by poorly prepared surfaces or poor solution chemistry. Chemical methods are needed to test surface preparation and to monitor and control plating processes, including solution chemistry. Improved testing methods would benefit production efficiency and ensure more consistent application of the protective coatings. Corrosion analysis tests can also help to identify the causes of corrosive attack and ultimately suggest protective or corrective actions.

Testing methods to determine the performance characteristics of lubricants and oils are needed as mechanical designs are pushed to severe limits. The early detection of lubricant degradation or failure through on-line monitoring could prevent excessive wear on many components and extend useful product life. Detection techniques and sensors are needed to allow monitoring of oil/lubricant quality in engines, transmissions, bearings, and in similar situations.

TABLE 4

SUMMARY OF TESTING NEEDS BY TEST TECHNOLOGY

TESTING TECHNOLOGY	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Mechanical Testing	Materials Testing - Metals and emerging materials, i.e., armor and antiarmor materials, composites, ceramics, elastomers, etc. Material property characterization, classical physical parameters, (tensile, compressive, etc.) Vibration, Shock, and Ballistic Testing Standards, Procedures, and Acceptance Criteria
Chemical Testing	Oil and Lubricant Evaluation Methods - Detection of lubricity degradation due to excessive wear, environment extremes, etc. On-line analysis techniques Paints, Coatings, and Sealant Testing - Shelf life testing methods Agent and decontamination susceptibility Plating Processes - Solution chemistry monitoring techniques Plating process control techniques Nuclear, Biological, Chemical Agent Testing - Testing using chemical agent simulants Reductions of hazardous waste generation Hazardous waste monitoring techniques
Nondestructive Testing	Plating Evaluation Methods - Plating surface preparation evaluation methods Plating thickness and adhesion testing methods In-process control techniques for plating Adhesive Bonds - NDE methods for bond integrity and strength Detection techniques for delaminations and bondline thickness Detection techniques for surface contamination or improper preparation Composite Materials - NDE methods for defect detection, internal damage, improper lay-up, improper curing, etc. Technology for ultrasonics, acousto-ultrasonics, thermography, x-ray & neutron radiography, etc. Metals - Detection of microstructural damage, i.e., hydrogen embrittlement, grinding burn damage, residual stress, etc. Automated and Intelligent NDE Systems - NDE data analysis and decision support Vision systems, expert systems, artificial intelligence

TABLE 4 (Continued)

SUMMARY OF TESTING NEEDS BY TEST TECHNOLOGY

TESTING TECHNOLOGY	PROMINENT TESTING NEEDS IDENTIFIED IN SURVEY
Electronic/Software Testing	Test Automation - Expert systems, artificial intelligence, automated data analysis, imaging technology Component, Circuit, and Subsystem Testing Methods - Reliability testing of electronic components Shock, vibrations, high-g event simulation Soldering Technology - Solder joint integrity testing Software Testing - Verification of software algorithms and models Battlefield networking (software & hardware) Expert systems & artificial intelligence
Other Testing Technology	Hazardous Wastes Monitoring and Control MANPRINT Testing - Human compatibility testing of Army commodities, food items, materials, equipment, etc. Environmental Testing and Compatibility - Testing of Army commodities in harsh environments

U.S. ARMY TESTING NEEDS SURVEY
PROBLEM SUBMISSIONS BY TEST TECHNOLOGY

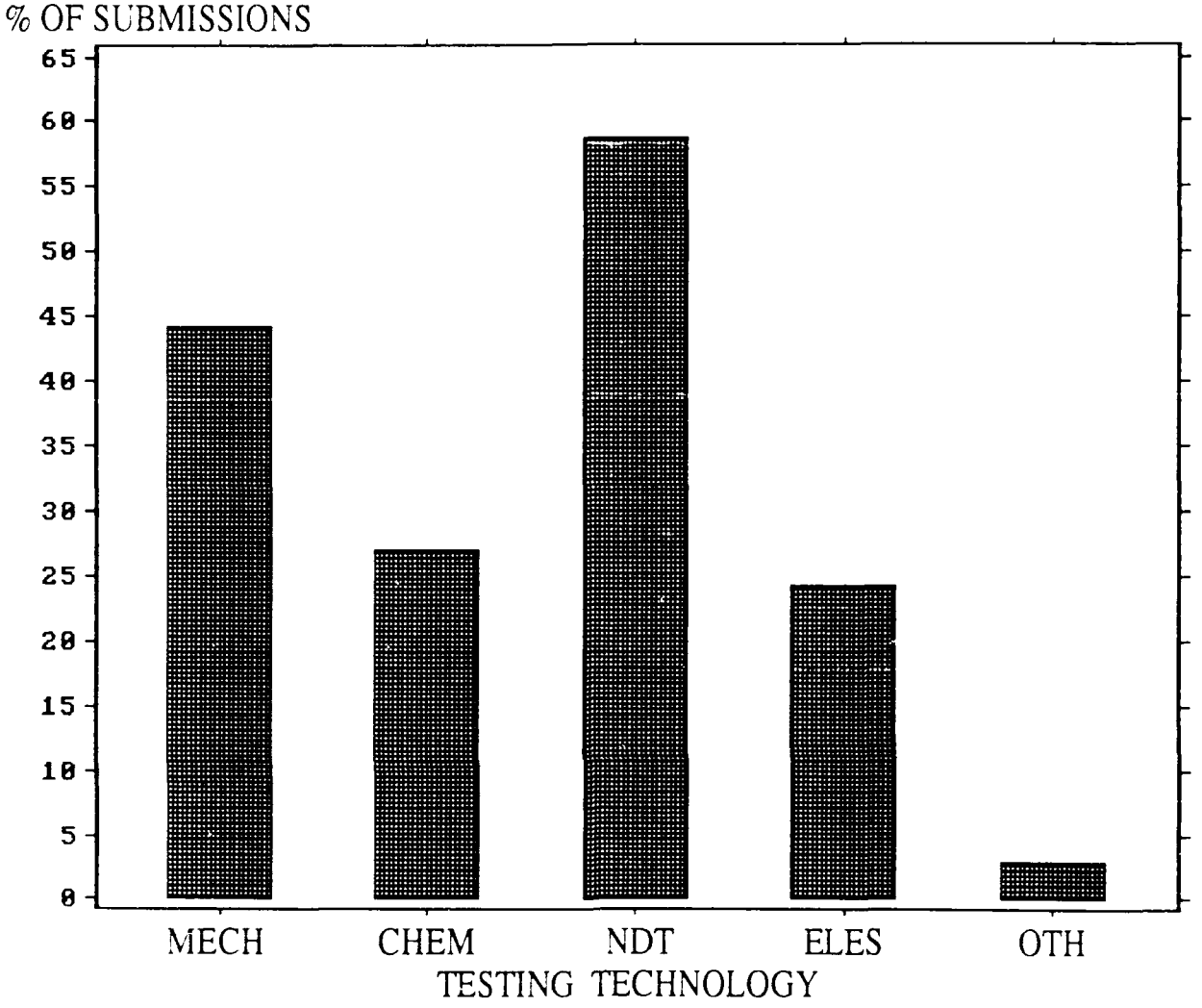


Figure 3. This chart shows the percentages of the Testing Needs Survey submissions organized by Testing Technology. Since some submissions included the use of multiple testing technologies, total percentages exceed 100%.

Legend: MECH - Mechanical Testing Technology
CHEM - Chemical Testing Technology
NDT - Nondestructive Testing Technology
ELES - Electronic and Software Testing Technology
OTH - Other Identified Testing Technology

The Army uses many different types of paints, coatings, and sealants. A need has been expressed for testing methods to reliably determine the condition of these materials during and after long-term storage. Currently, an expiration date is relied upon to decide whether or not these materials are still useful. It is believed that many of these coatings could be used beyond the posted expiration date if a simple and reliable testing technique were available.

Testing for protective and defensive measures against chemical agents involves the use of hazardous materials. Testing methods are needed which utilize more benign chemicals, but which also accurately model the aggressive nature of the agents. This type of testing may involve the development of new chemicals or compounds that can react in similar fashions and safely indicate aggressive action. Testing techniques are also needed to conduct field sampling for chemical agent use and to verify decontamination efforts. Chemical testing also generates significant amounts of waste products which themselves are very hazardous. Disposition of these wastes is becoming a serious problem for the Army. Neutralization techniques are needed to alleviate this problem not only for chemical testing by-products but also for wastes generated by plating processes and many other chemical processes common in the Army.

3.4.3 Nondestructive Testing

The testing technology most frequently requested in the survey of testing needs was that of nondestructive testing. All of the techniques commonly associated with NDT were in demand; visual/optical inspection, penetrant, ultrasonics, acousto-ultrasonics, acoustic emission, radiography (x-ray, gamma ray, neutron, tomography), infrared thermography, electromagnetics, and vibration/modal testing. Other emerging NDT methodologies have been considered in this category. Excluded from this category, however, is the determination of the functional characteristics of electronic devices, computers, and programs.

The NDT needs specified in the survey were focused in applications such as aircraft, gun tubes, engines and components, and advanced materials. Once again, the need for improved plating materials, techniques, and process control methods is apparent in this category of survey responses. Process control techniques are needed for implementation at the manufacturing and maintenance stages of many Army commodities. Improved plating materials and simply more consistency in the application of platings can extend part life and enhance reliability. Other processes such as welding, propellant manufacturing, and machining operations can benefit from the use of process control technology. Aircraft structures also suffer from hidden corrosion which can result in serious defects. NDT methods are needed to inspect these structures and reveal the presence of corrosion or the conditions which promote corrosive attack.

In gun tube applications, loss of plating material leads to accelerated wear and a degradation of weapon accuracy. Implementation of vision system technology in tedious visual inspections (such as gun tube inspections) can improve the consistency and accuracy of these types of examinations.

The trend toward the use of lighter weight, high-strength materials is accompanied by the need for new and specialized testing techniques. Composite materials are already widely used in aircraft structures, and are gaining use in advanced weapons designs. NDT techniques are urgently needed for accurate and reliable detection of internal damage in these materials. Often, damage due to impacts and loading conditions is not apparent from the external condition of these materials. Ceramic and ceramic composite materials are also in need of NDT methods for use in the curing or manufacturing stage and during the life of these parts.

The use of adhesives in bonding materials together is also gaining use due to strength to weight advantages. However, bond integrity can also be compromised by poorly prepared adhesion surfaces and adhesives, and by the intrusion of moisture into the joint. Current

testing methods depend on standardized sample testing and adherence to procedures. Sample test methods, such as the lap shear test and the peel test, do not accurately model the adhesive loads or situations of real-world applications. Some NDT methods are currently in development to assess bond integrity in-situ; for example, ultrasonics and acousto-ultrasonics, thermographic, and radiographic methods. However, these methods remain to be refined and are largely limited to the laboratory setting. Since adhesives are used in critical situations such as rotor blades and aircraft control surfaces, the urgency for the development of adhesives NDT methods is clear. Initiatives to improve adhesive bonding are already underway within the Army; efforts should be promoted to implement field testing techniques for bonds as well.

Conventional structural materials, such as steel and aluminum alloys, continue to be in need of NDT techniques also. Testing methods are needed to characterize micro-structural material conditions, such as hydrogen embrittlement, grinding burn damage, residual stress, and other conditions. Glass and plastic materials used in windshields and optics are in need of techniques to detect degradation due to exposure and scratches. Leak detection methods are needed for both fuel storage tanks and on-board tanks such as in aircraft. NDT techniques are in demand for quality monitoring of oils and lubricants in engines and transmissions. Finally, a general need to implement automated and intelligent inspection systems is clearly in demand across all Army commodity commands. The driving factors are to improve inspection accuracy and consistency, and reduce inspection time. A common thread in the requests is the desire to remove ambiguous and inconsistent human interpretation of test data.

3.4.4 Electronic and Software Testing

Considered in this category of testing technology are those problems which are concerned with the performance characteristics of electronic devices, components, and subsystems. Computer hardware testing and computer software testing and verification is also included. This category does not include the testing of the electronic materials themselves.

Testing needs involving electronic techniques and software methodology were focused in test automation, electronic component and circuit evaluation, and software modeling and simulation. As mentioned in previous sections, automation of testing processes is a common need throughout Army materials testing programs. Coupled with the mechanics of automating test procedures, the use of expert systems, artificial intelligence, or other software methods are needed to assist in decision processes in materials testing. Imaging technology can be used effectively for tedious visual inspections or for interpretation of test data with appropriate processing software.

Electronic components, circuits, and subsystems are in need of testing techniques which can identify failure modes due to electronic transients and the physical environment. Vibration testing techniques typically excite single-axis movement; 2-axis and 3-axis vibration environment simulation is also needed for more accurate testing. Techniques for shock testing at high-g loads are needed for ballistic events and missile subsystems operating in unusually severe environments. Methods are needed to simply monitor the real-time loading of these high-g situations. On the circuit board level, methods are needed to more rapidly evaluate circuit board assemblies. Flaws in soldering must be detected in early stages of manufacturing to avoid premature failures in field situations. Efforts must also be made on testing methods which can indicate probable failures or suggest the remaining life of electronic systems.

Modern computer technology has been very useful in mathematically modeling new engineering designs. These computer models help designers test their designs against modeled load conditions before being committed to production. The results are more efficient mechanical designs and greater reliability. Modeling of newer designs, though, is taxing current computer resources and capabilities. Accurate modeling of these situations will require greater computing

speeds and larger memory capacities. Reliable and redundant computer resources are needed in battlefield situations as well. This technology is becoming essential to CCCI functions in the field.

3.4.5 Other Testing Technologies

A few testing needs submitted to the survey team warranted categorizing separately. Those problems which, because of their nature, are not generally covered by one of the test technology categories above have been collectively considered here.

Environmental issues involving the use and disposition of hazardous wastes have affected the testing methods used in several Army sectors. Chemical processes used in the manufacturing of parts and supplies generate waste products that are accumulated and stored for later disposition. Respondents in the survey noted that control of these waste stockpiles will require careful testing to detect and prevent contamination of the surrounding environment; those testing methods are in need of development and implementation. The development of appropriate neutralization techniques may also help by minimizing the quantities of these hazardous by-products.

The testing of personnel supplies and materials requires a battery of diverse compatibility tests. A concept called MANPRINT quantifies differences which affect compatibility with the soldier; such differences include proportions of human anatomy, human behavioral and perception patterns, and other features. A need was expressed to expand on this concept to standardize acceptance testing of personnel supplies.

Environmental exposure testing might also be considered a specialized test technology category. Many Army commodities require some form of environmental stress screening by military specification. However, in many situations, environmental testing equipment is not available for all requirements. Greater availability of environmental stress screening facilities is needed for those situations; or a review of the requirement may be appropriate.

4. SUMMARY AND CONCLUSIONS

The Testing Needs Survey received responses from all Army Major Subordinate Commands representing the various Army materiel categories. The survey has identified several testing technologies and product categories which have common needs requiring solutions through test methodology. These testing needs are driven by the emergence of new materials, by new designs operating to more severe limits, and by the constant effort to improve system reliability. The findings of the survey are summarized below in an effort to prioritize the needs. In this way, the Army can effectively focus available resources on the testing needs which are in demand and which have commonality across commodity categories. The Army's desire to remain current with materials technology and the testing methods required to evaluate those materials indicates a need to maintain an effective mechanism to assess its technology awareness.

4.1 Major Testing Needs Identified in Survey

Nondestructive evaluation techniques in general were the main technology requested in the surveyed testing needs. Almost every Army product or system requires some sort of NDE inspection during its life. Inspection methodologies are available; however, NDE expertise and equipment is limited. Newer techniques are also needed for more reliable inspections and for applications to the emerging materials. These shortcomings emphasize the Army's need to focus resources in addressing NDE technology needs in a concerted effort. Perhaps the most evident NDE needs involve the detection and assessment of corrosion problems, the evaluation of adhesive bond integrity, and composite materials evaluation. While these problems are the subject of current Army attention, their importance to Army-wide interests should be promoted through coordinated and continued efforts.

The methods used to evaluate most Army products in the manufacturing stage and later during the life of the products are generally well established techniques. Significant gains can be achieved in product evaluations by utilizing modern automation technology with the established testing techniques. This concept of automating testing processes was also in clear evidence in the survey responses. The advantages to be gained in product evaluations would be increased production efficiency, greater test accuracy, and improved product reliability. Process control techniques implemented at the manufacturing stage have a significant potential for cost savings by controlling quality at a very early stage of production. Also, savings in lost materials, reduced rework time, and end item testing can benefit many Army manufacturing processes.

Throughout the survey and across commodity categories, composite materials were found to influence many testing needs. The variety of these materials, their performance characteristics, and their applications make common testing techniques difficult to achieve. Nevertheless, the wide appeal and distinct advantages of these materials indicate a clear need to establish methods to accurately evaluate all aspects of their performance. Mechanical and NDT methods for composites should be regarded as the primary needs for evaluating these materials. As newer composites are formulated, testing technology must keep pace. Emerging materials such as ceramics, polymers, and elastomers were frequently targeted for testing needs in the survey responses.

The specific Army products receiving most attention in the survey were gun tubes, aircraft components, personnel items (clothing and protective items), and engines and components. The testing needs associated with gun tubes involved testing at both the manufacturing stage and during the service life of the components. Machining processes for gun tubes required more accurate control, and plating processes required both control and evaluation techniques. Gun tube inspection techniques and live-fire methods were in need of advancement. Aircraft testing needs included corrosion assessment problems, adhesive bond inspection (including the use of composites in bonded structures), and engine, bearing and transmission wear evaluation concerns. Personnel

protection items were in need of testing methods to evaluate their effectiveness against agent penetration. Engine testing needs focused on plating assessment, automated testing methods, and dimensioning techniques.

4.2 Recommendation for Maintenance of Testing Needs Information

Many common materials problems and testing technology needs exist throughout the various Army commodity commands. This fact has been made clear in the responses obtained in this survey. A mechanism is needed to assess on a regular basis the overall materials testing needs throughout the Army. Because of budget constraints and considerations, it has become imperative that a redundancy of efforts be minimized as much as possible without sacrificing vital materials and systems development. To accomplish this, a wider view of Army materials testing needs is suggested in the form of a regular Army-wide survey and database. This would allow the identification of common areas in which more coordinated efforts could be undertaken to the benefit of all commodity commands. A focusing of resources, including personnel, equipment, and funds, could promote more productive efforts in locations particularly qualified to address the specific issues. This approach would avoid the fragmentation of valuable resources within the Army. A clearer direction toward common Army goals may generate more timely technology developments for implementation at the appropriate sites.

TABLE 5

SUMMARY OF MAJOR TESTING NEEDS IDENTIFIED IN SURVEY

TESTING NEED/ITEM	APPLICATION OR SPECIFIED TEST SITUATION
Nondestructive Evaluation Methods and Techniques	Plating Evaluation Methods - Wear, thickness, adhesion, plating processes Adhesive Bonds - Bond integrity and strength determination Composite Materials - Defect detection, internal damage, improper lay-up, state of cure, etc.
Automated Testing Equipment and In-Process Control Techniques	Automated Inspection Techniques and Equipment - Automated manufacturing, maintenance, and field testing Process Control Methodology - Manufacturing, machining, and maintenance Plating process control (gun tubes, aircraft, etc.) Welding process control and inspection
Composite Materials and other Emerging Materials	Mechanical Tests Specific to Composites and Ceramics Inspection/NDE Methods for Composites, Ceramics, etc. Damage Assessment, Repair, and Maintenance Methods Guidelines, Procedures and Standards for Emerging Materials Modeling and Evaluation Software for Emerging Materials
Gun Tubes	Manufacturing Processes - Control techniques for machining processes Control techniques for plating processes Maintenance and Field Evaluation - Plating inspection techniques Corrosion and wear assessment methods
Aircraft Components	Engines, Structures, Components - Wear inspection, evaluation, and monitoring Corrosion detection, control, and prevention Plating evaluation, process control techniques NDE methods for adhesively bonded structures
Personnel Items and Support Equipment	Clothing, Suits, Masks, Fabrics, Strapping - NDE methods for aging due to exposure Environmental durability testing NBC Agent Defense State-of-the-art effectiveness testing Rapid, automated detection techniques (lab/field) Food Quality, Storage Stability, Container Testing
Engines and Components	Plating Process Control Techniques Plating Inspection Techniques Wear Evaluation and Monitoring Techniques Oil and Lubricant Quality Monitoring and Evaluation Machining, Dimensioning, and Tolerance Testing

APPENDIX A

MTT PROGRAM SUCCESS STORIES - SEVEN EXAMPLES

APPENDIX A - TABLE OF CONTENTS

APPENDIX A.1

AUTOMATIC FUZE INSPECTION BY RADIOGRAPHY

AUTOMATIC FUZE INSPECTION BY RADIOGRAPHY

PROBLEM

Current methods of radiographic inspection of Army fuzes are subjected to human judgment and human production limitations, which can lead to inspection errors and potentially dangerous conditions in the munitions items. Labor costs are associated with the interpretation of radiographic images and the preparation of inspection reports. Also, the use of x-ray film or paper represents direct costs for materials and film processing labor, as well as indirect costs due to the time delay for processing and the consequent need for holding areas and associated record keeping.

BENEFITS

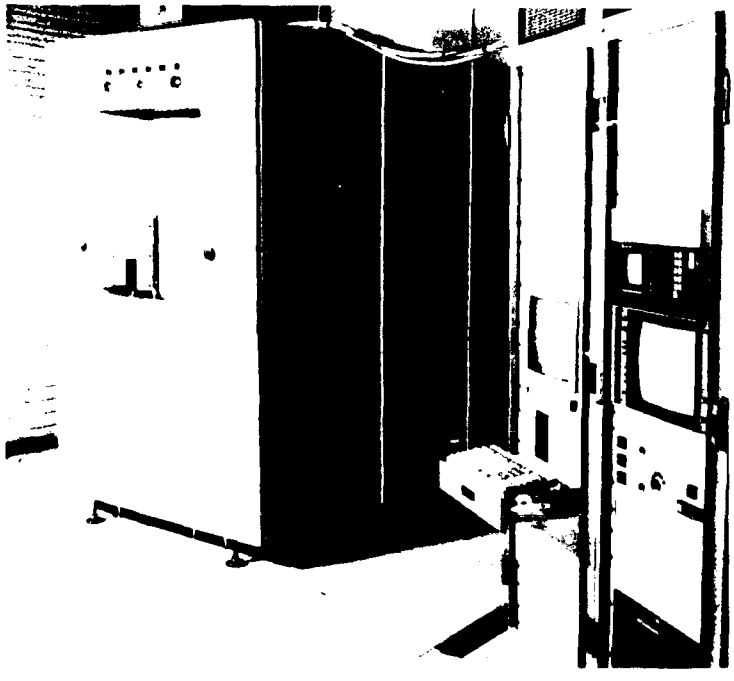
Improved product reliability and safety
Improved productivity
Reduced costs

ECONOMICS

Savings: $ 530,000/yr single site implementation
956,000/yr second site implementation
$1,486,000/yr total savings

STATUS

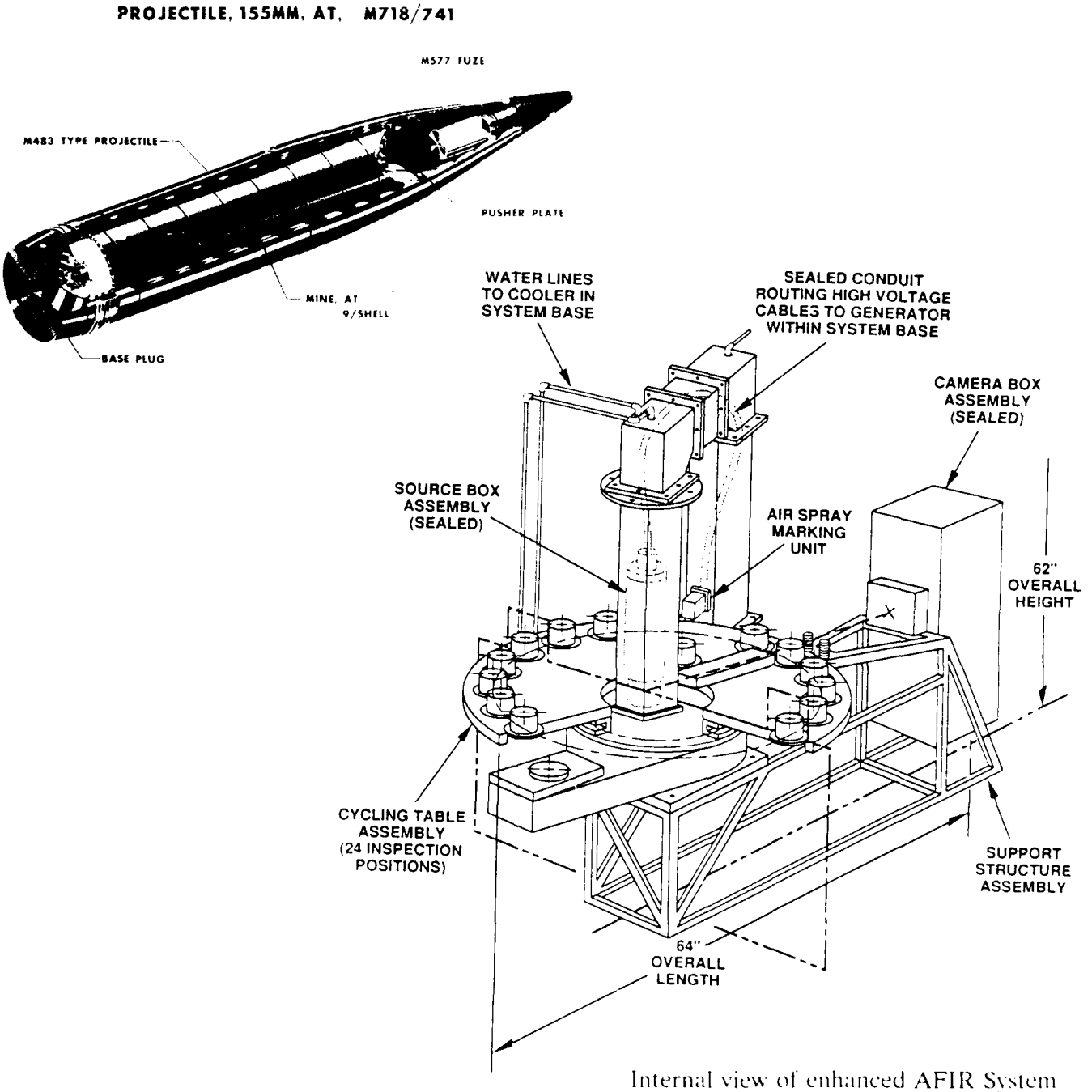
Implementation: August 1989
Location: Iowa Army Ammunition Plant
(Second site, Milan Army Ammunition Plant)
End Item: Projectile, 155mm, RAAM, M718/M741
Projectile, 120mm, HEAT, M830
Cartridge, 40mm, HEDP, M430



AFIRS System

AUTOMATIC FUZE INSPECTION BY RADIOGRAPHY

This MTT project resulted in a prototype piece of equipment that automatically inspects munition fuzes by use of real-time filmless x-ray imaging and computerized image analysis. Both hardware and specialized software were developed under the project. The system not only provides immediate accept/reject decisions but also furnishes a printout of specific defect attributes on each fuze, statistical data on groups of fuzes, and digital image recording of all fuzes for archival records. Although developed for application to RAAM mine fuzes, the system can be easily programmed and adapted to other items. This equipment has already been adapted to inspect the M764 fuze used in M830 120mm projectiles, and a similar system is being built for the M549 40 mm fuze.



Internal view of enhanced AFIR System

APPENDIX A.2

MAGNETIC FLUX LEAKAGE INSPECTION SYSTEM

MAGNETIC FLUX LEAKAGE INSPECTION SYSTEM

PROBLEM

The M433 stockpile of seven million machine gun cartridges has been permanently suspended because of several malfunctions caused by cracking. Inadequate methods exist to detect cracks in this stockpile and other generic cartridge programs, such as the M384 40mm high explosive cartridge.

BENEFITS

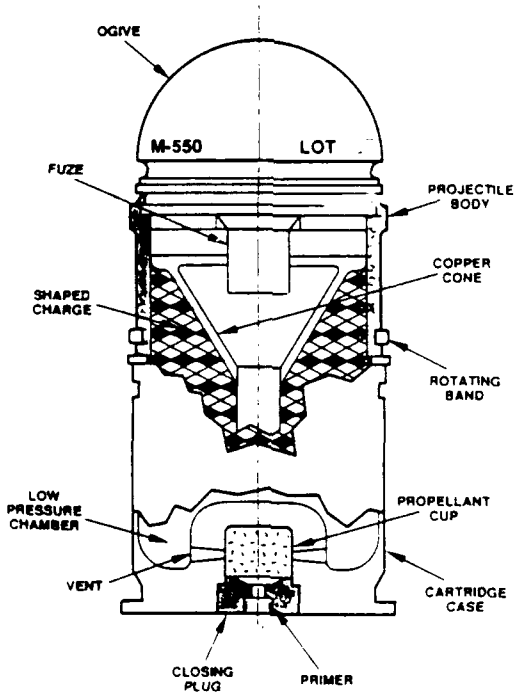
Screening of defective rounds
Improved safety
Reduced cost

ECONOMICS

Savings: $70,000,000 (after stockpile screening in July 1989)
Savings to investment ratio: 140 to 1

STATUS

Implementation: In process
Location: Milan Army Ammunition Plant (MAAP)
End items: M34 40 mm HE cartridges; M433 cartridges used in MK19 machine gun; M42/M46 grenades

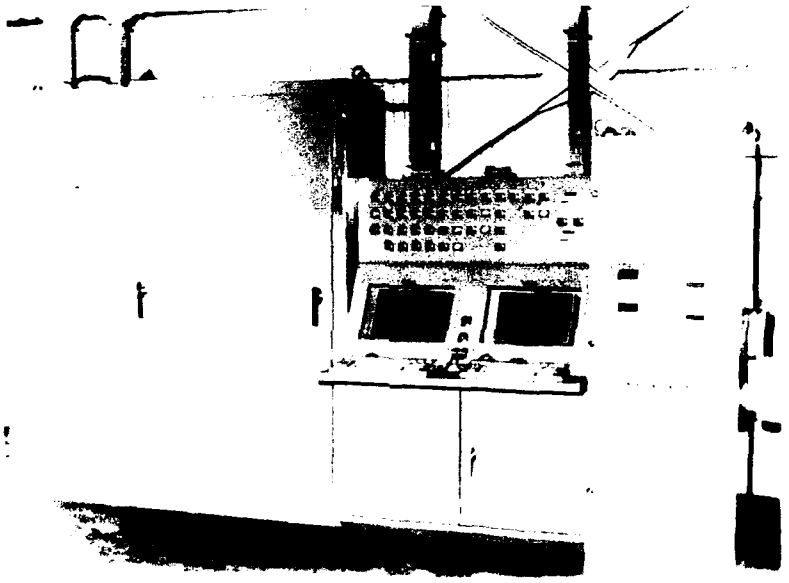


Cartridge, 40 mm: HEDP, M433

MAGNETIC FLUX LEAKAGE INSPECTION SYSTEM

A magnetic flux inspection system (MFLIS) has been installed at Milan AAP for the screening/ renovation testing of M384 40mm high explosive cartridges. The system will automatically and nondestructively detect anomalies throughout the part, including within the steel body on the inside or outside diameter or within the walls of all surfaces, regardless of orientation.

A spin-off implementation application is to convert an MFLIS system for screening seven million machine gun cartridges. There is no NDT method available to screen this ammunition except MFLIS. Implementation on the stockpile is expected in 1989.



MFLIS System

APPENDIX A.3

MOBILITY MONITORING SYSTEM

MOBILITY MONITORING SYSTEM

PROBLEM

Lack of availability of instrumentation for vehicle endurance testing

BENEFITS

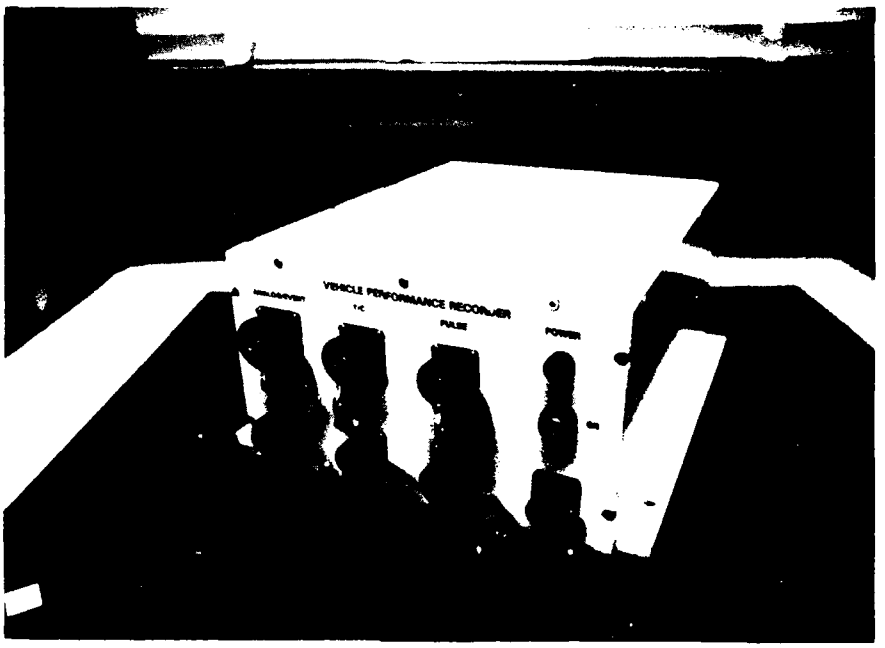
Enhanced testing capability
Cost reduction
Improved productivity

ECONOMICS

Savings: $500,000 per test (estimated)
Savings to investment ratio: 2 to 1

STATUS

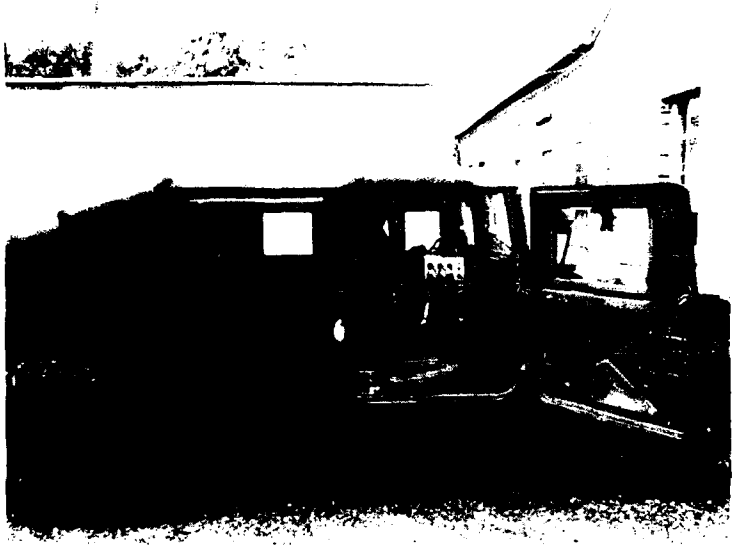
Implementation: Completed
Location: Combat Systems Test Activity (CSTA), Yuma Proving Ground
Cold Regions Test Center (CRTC)

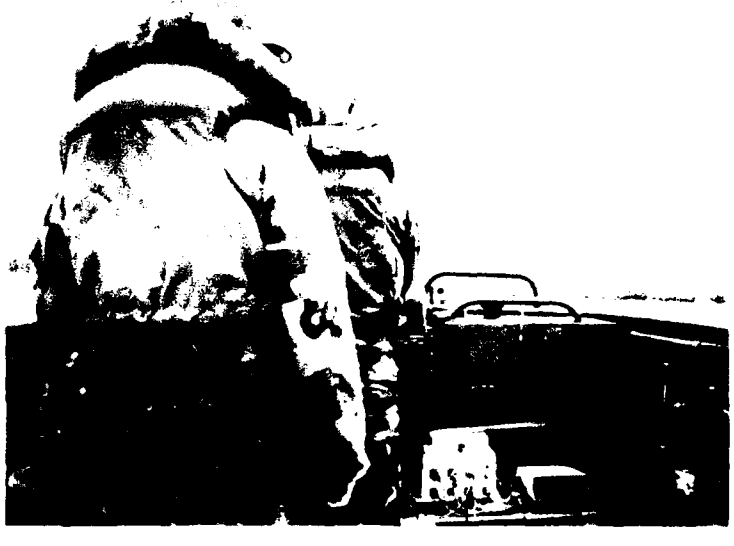


Mobility monitoring system vehicle performance recorder

MOBILITY MONITORING SYSTEM

Endurance testing requires rugged instrumentation. Most ruggedized instrumentation is either large and heavy or has low performance (low sample rates and/or a small number of data channels). This MANTECH project developed a set of high-performance, rugged data recorders. These recorders, available in 32-, 64-, and 256-channel versions, contain onboard signal conditioning. Data compression algorithms are available to provide up to a 1000-to-1 reduction (histogram) in stored data values, allowing long duration, high sample rate testing. The Mobility Monitoring System connects both measured (temperature, vibration) and control (driver name, test course) type data. The system has been used to test a variety of wheeled and tracked vehicles.





Mobility monitoring system mounted in vehicle (top photo) and bridge boat (bottom photo)

APPENDIX A.4

TRIAXIAL VIBRATION TEST METHOD FOR MISSILE/ARTILLERY FUZE MATERIEL

TRIAXIAL VIBRATION TEST METHOD FOR MISSILE/ARTILLERY FUZE MATERIEL

PROBLEM

Uniaxial acceptance/qualification vibration tests of fuze and electromechanical ordnance materiel are inefficient because life cycle, simultaneous, multiaxis vibrations are not reproduced; potential operational/safety flaws cannot be precipitated; and the procedure is time consuming (repeated three times).

BENEFITS

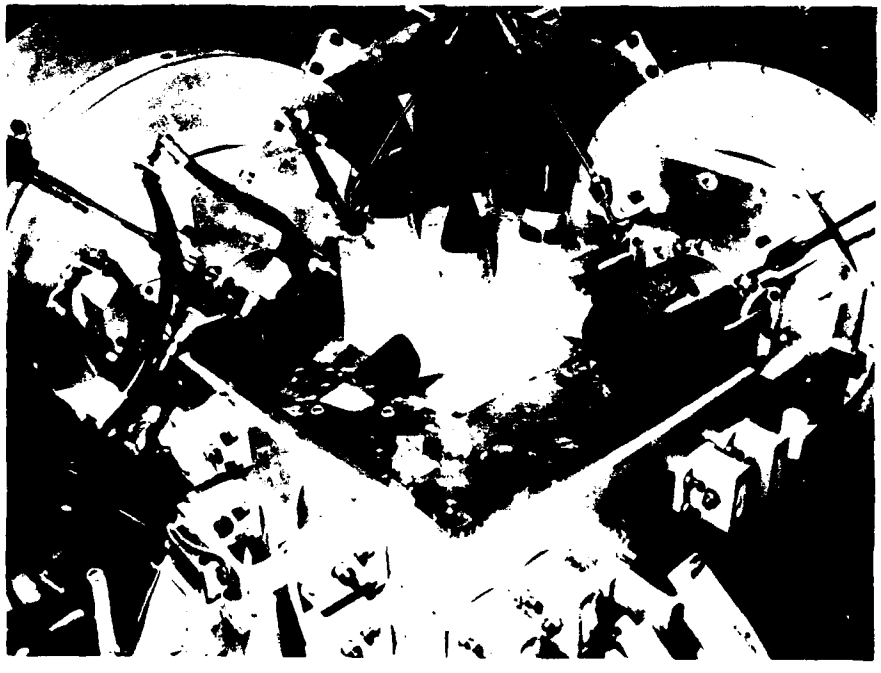
- Upgrade of materiel quality/reliability
- Improvement in materiel safety
- Reduction in test time by 67 percent
- Reduction in manufacturing cost through the tailored test process

ECONOMICS

Cost avoidance estimate: $2 million
Savings to investment ratio: 10 to 1

STATUS

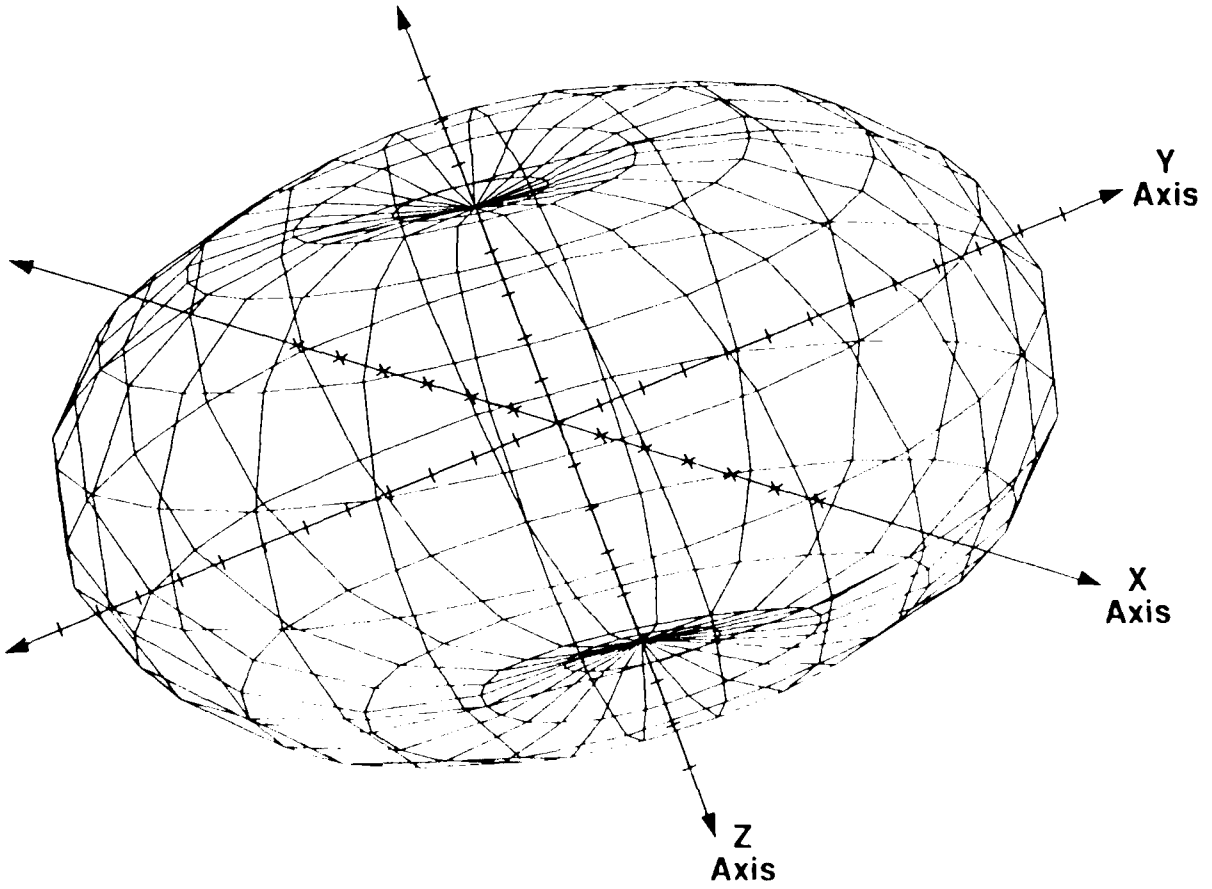
Implementation: in process
Location: HDL, Adelphi, MD (301) 394-2806
Items supported: Patriot, M732, MLRS, Traffic Jam, 5-ton Tactruck, Field x-ray, miscellaneous fuze materiel. Any item up to 1000 pounds within a 2-ft square attachment surface to MIL-STD level



M732 artillery fuze - transportation vibration test setup on triaxial tester

TRIAXIAL VIBRATION TEST METHOD FOR MISSILE/ARTILLERY FUZE MATERIEL

The uniaxial vibration method used in acceptance/qualification testing of fuze materiel does not produce multiaxis life cycle vibration, nor does it serve as a practical tool for verifying safety in many spatial directions within the test item. Therefore, operational and safety-related flaws are inadequately screened. A new triaxial, random vibration method was developed that reproduces the measured field vibration in three axes simultaneously, thus reducing test time by 67 percent. The method was demonstrated up to 15 G rms and 2000 Hz with a 100-lb payload, indicating good compliance with MIL-STD requirements. Several impressive achievements were demonstrated, including (1) detection of manufacturing and design-related flaws that were not precipitated, despite rigorous uniaxial tests per MIL-STD-810 criteria, and (2) repeated precipitation of the identical failure modes experienced in the field (Traffic Jam PS; 5-ton Tactruck Transmission CU). HDL fuze programs that will be using triaxial vibration tests include the Patriot, M732, and MLRS, as well as related electromechanical ordnance components. The method's superior test realism provides for an efficient laboratory procedure that will reduce the cost of expensive field tests of any Army materiel while preserving the test hardware--a significant advantage in testing missile/aviation materiel.



Patriot missile fuze--3D vibration energy envelope for triaxial flight vibration test (rms)

APPENDIX A.5

GAS PHASE LEAKAGE TESTING OF PROTECTIVE MASKS

GAS PHASE LEAKAGE TESTING OF PROTECTIVE MASKS

PROBLEM

Current challenge media yielded imprecise results, could not be detected at low leakage levels, and required excessive maintenance.

BENEFITS

Consistent leakage results
Detection of low-level leakage
Reduced maintenance costs

ECONOMICS

Savings: $500,000 per year

The primary purpose of the project was to improve consistency of results and lower the threshold of leak detection. However, a savings/investment ratio of 3.99 is anticipated.

STATUS

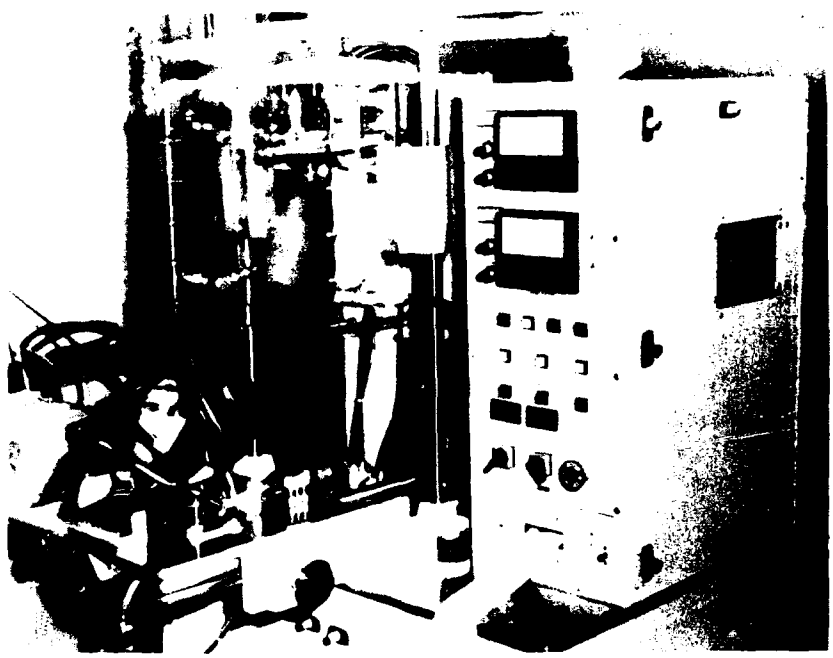
Implementation: In process of applying technology to automated protective mask leakage tester; scheduled completion date is August 1991.
Location: Armament, Munitions and Chemical Command, Chemical Research, Development and Engineering Center; surveillance and surety sites worldwide; protective mask production contractors.
End Items: M17 and M40 series protective masks.

Protective mask

GAS PHASE LEAKAGE TESTING OF PROTECTIVE MASKS

This project developed inexpensive technology for detecting gas traces using Freon-12 and sulfur hexafluoride as challenge media. Currently, protective mask leakage testing is performed using a liquid aerosol as the challenge medium. The aerosol method is less precise and, because of the size of the aerosol particle, requires a significantly larger leak path to exhibit leakage. Also, the aerosol reacts with, and congeals in, the plumbing, thus requiring extensive preventive and corrective maintenance.

In this project, the current M14 Protective Mask Leakage Tester was modified to permit testing with either medium. Comparison testing was performed using M17 protective masks. Sulfur hexafluoride and Freon-12 provided more consistent data and could be detected at much lower levels than the aerosol. Currently, work is being performed to implement this technology to an automated protective mask leakage tester to be type classified as the M14A1. Although implementation is still pending, analysis indicates a savings/investment ratio of 3.99.



Gas phase leakage testing apparatus

APPENDIX A.6

AUTOMATIC ARTILLERY ROCKET GRAIN INSPECTION SYSTEM

AUTOMATIC ARTILLERY ROCKET GRAIN INSPECTION SYSTEM

PROBLEM

An automatic inspection system for propellant grains is needed to replace current visual and radiographic methods, which rely on human interpretations that are sometimes erroneous. Porosity or cracks in propellant grains can cause rapid burning and overpressure, resulting in a critically short round. A short round can risk lives of personnel, jeopardize mission accomplishment, and result in costly malfunction investigations.

BENEFITS

- Provides state-of-the-art inspection for rocket grains.
- System can be easily adapted to inspection of other grain types.
- System uses no chemicals that require treatment or disposal.
- Analysis subjectivity is consistent and controllable.
- Condition classification is immediate.
- Inspection time is reduced.
- Data archival is space-saving.
- Environmental factors are improved through data archiving.

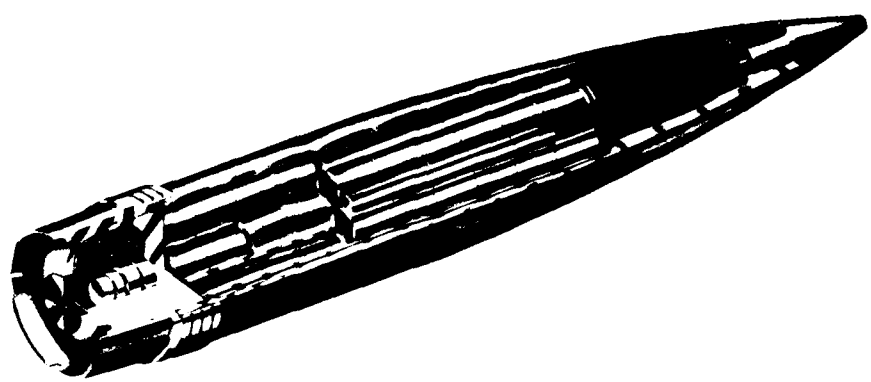
ECONOMICS

Savings: $129,000 per year for 10 years
Savings to investment ratio: 12.999

STATUS

In process

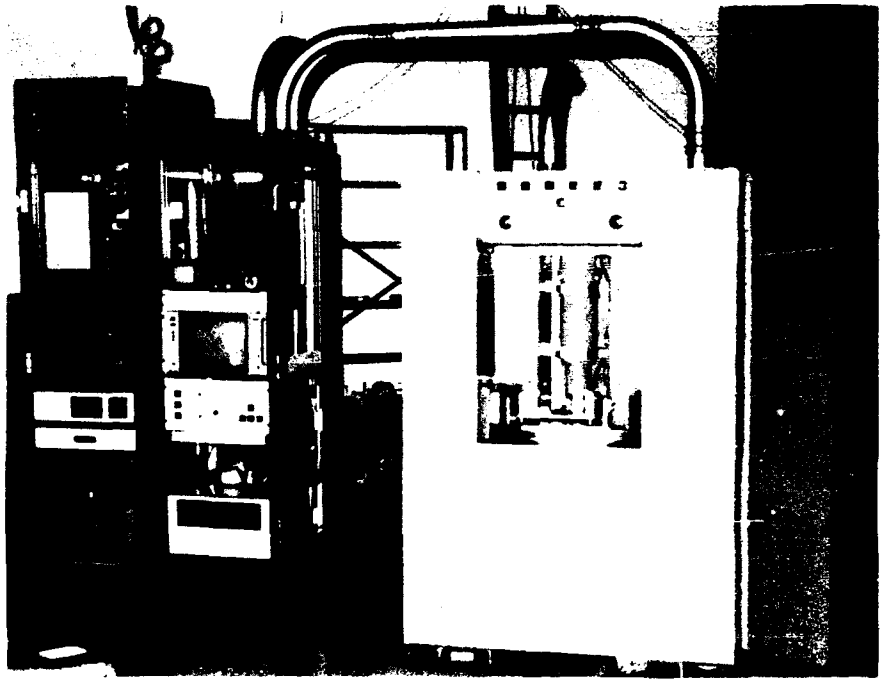
155MM, XM864, DPICM PROJECTILE



AUTOMATIC ARTILLERY ROCKET GRAIN INSPECTION SYSTEM

This program was inaugurated to develop an automated, real-time x-ray inspection system for detecting flaws and porosity within the body of propellant grains. The new system will replace the current visual and radiographic system that is expensive, labor intensive, and highly subjective.

The system will be developed employing x-ray technology and computerized decision making. A trade-off analysis has selected a photon transmission rather than a Compton scattering method. One prototype system will be designed and fabricated on contract for direct implementation in a propellant manufacturing plant.



Automatic artillery rocket grain inspection system

APPENDIX A.7

STATE-OF-CHARGE METER FOR NON-RECHARGEABLE LITHIUM BATTERIES

STATE-OF-CHARGE METER FOR NON-RECHARGEABLE LITHIUM BATTERIES

PROBLEM

Lack of knowledge by users regarding the capacity remaining in lithium/sulfur-dioxide batteries has led to costly, premature disposal of these batteries. Field studies and examination of batteries marked for disposal have verified that lithium batteries are being disposed of before all useful life has been expended.

BENEFITS

Widespread use of a state-of-charge device has the potential of saving the Army millions of dollars per year through complete usage of the batteries. Also, use of the meter will give soldiers confidence that a partially used battery has sufficient capacity to accomplish a mission.

ECONOMICS

Savings: Approximately $10 million per year

STATUS

Program initiated in FY88.
Prototype state-of-charge meters have been purchased in FY89.
Prototype units were lab tested and field demonstrated at Fort Bragg and Fort Lewis.
Quantities of meters are planned to be purchased in FY90 for field testing.

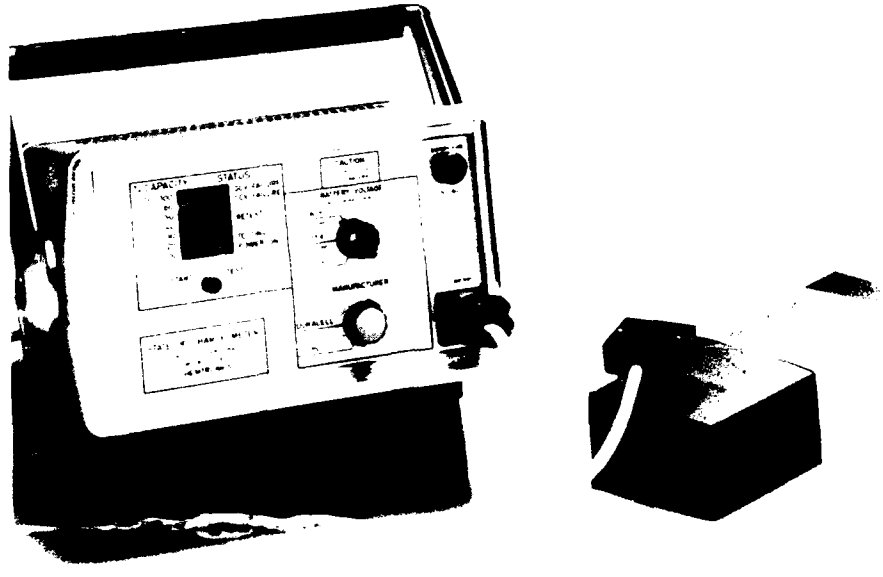
Field soldier with AN/PRC-119 SINCGARS radio set

STATE-OF-CHARGE METER FOR NON-RECHARGEABLE LITHIUM BATTERIES

Unlike other electrochemical systems, the lithium system does not possess the simple characteristics required for measuring remaining capacity (e.g., sloping voltage). A method for state-of-charge determination of a lithium/sulfur-dioxide battery has been fabricated and tested. Field demonstrations of prototype meters showed that lithium batteries marked for disposal had an average remaining capacity of 50 percent. Field tests also revealed that approximately 45 percent of these batteries had a remaining capacity of 75 percent or more.

Soldiers in the field stated that they were reluctant to employ a used battery because they had no way of knowing whether the battery was good or bad. They further stated that they would consider a battery with 75 or more percent to be "new," and that a reliable meter would give them confidence that a partially used battery had sufficient capacity to accomplish a mission.

Widespread use of a state-of-charge meter would not only save millions of dollars but would also reduce logistics cost (fewer batteries would have to be purchased) and would greatly increase battery user confidence.



Lithium battery state-of-charge meter

APPENDIX B

AMC/MTL TESTING NEEDS SURVEY DOCUMENTS

APPENDIX B - TABLE OF CONTENTS

APPENDIX B.1

REFERENCE AMCQA-E LETTER DATED 7 MARCH 1988,
SUBJECT: AMC MATERIAL TESTING NEEDS SURVEY

DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY MATERIEL COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333-0001

S: 7 Mar 88
21 Mar 88

23 FEB 1988

AMCQA-E

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: AMC Materials Testing Needs

1. Per reference, the Materials Technology Laboratory (MTL), through the Materials Testing Technology (MTT) Program, strives to bridge the gap between testing/inspection technology and application requirements. To assist in the identification of these requirements, MTL needs your help in performing a comprehensive survey of those areas requiring more advanced testing methodology, including those testing/inspection procedures with high cost/performance ratios. Special emphasis will be placed on depot test/inspection needs to assist in the HQDA "Depot 2000" program.

2. Request a point of contact be provided to MTL by 7 March 1988 for participation and support of this survey. Along with the MTT administrative support contractor, the Nondestructive Testing Information Analysis Center (NTIAC), MTL will develop survey questionnaires and provide composite visit schedules by 21 March 1988.

3. HQ AMC point of contact is Mr. E. D. Soliven, AMCQA-EQ, AUTOVON 284-8916/20, and MTL point of contact is Mr. F. Stenton, SLCMT-TMP, AUTOVON 955-5523.

4. Reference AMC Regulation 702-14, 2 January 1979, Materials Testing Technology (MTT) Program.

FOR THE COMMANDER:

Jerry L. Stahl

JERRY L. STAHL
Assistant Deputy Chief of Staff for
Product Assurance and Testing

23 FEB 1...

AMCQA-E
SUBJECT: AMC Materials Testing Needs

DISTRIBUTION:
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AVSCOM (AMSAV-Q)
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TACOM (AMSTA-Q)
TECOM (AMSTE-EV)
TROSCOM (AMSTR-Q)
DIR, MTL (SLCMT-TM)
HQ AMC, DCS FOR PRODUCTION (AMCPD)

APPENDIX B.2

REFERENCE SLCMT-MRM LETTER DATED 19 APRIL 1988,
SUBJECT: AMC MATERIAL TESTING NEEDS SURVEY

DEPARTMENT OF THE ARMY
U.S. ARMY LABORATORY COMMAND
MATERIALS TECHNOLOGY LABORATORY
WATERTOWN, MASSACHUSETTS 02172-0001

REPLY TO ATTENTION OF
SLCMT-MRM

19 April 1988

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: AMC Material Testing Needs Survey

1. Reference AMCQA-E Letter dated 7 March 1988, 21 March 1988, same subject (Enclosure 1).

2. Pursuant to the reference, this Laboratory will be conducting on-site reviews at AMC Major Subordinate Commands (MSC's) during the next several months to assist MCS's in identifying and describing AMC material testing needs. Enclosed herewith (Enclosure 2) is a copy of "FY1988 AMC Testing Needs Survey - Background Information." This document describes in general terms what the survey is intended to accomplish and how, probable sources of testing needs throughout the material life cycle, and categories of information. Your comments on this document are hereby solicited and would be appreciated.

3. A tentative schedule has been established for these reviews (Enclosure 3). The details of each visit (exact date, time, place, etc.) will be arranged and finalized between the appropriate MTL liaison and the point of contact for each installation. The MTL review team membership can and probably will vary with each visit, but will generally consist of the MTT Program liaison or a responsible representative of MTL, and a representative of the Nondestructive Testing Information and Analysis Center (NTIAC) which has been contracted to assist MTL in administ ring the survey.

4. Prior to, and in time for the scheduled visits, each installation should prepare to provide in-depth briefings on each identified testing need including any associated specifications, standards, drawings, visual aids, or other pertinent documentation. Each Command should assure the representation and participation at these reviews of Program/Project Managers within or associated with their Commands (see distribution).

5. It should be emphasized that "testing needs" are not necessarily "problems". If a need now exists or is anticipated it should be identified whether or not a possible solution can be proposed. This is particularly true in areas of high technology or high risk applications of new materials and processes (or high risk application of existing material and processes).

6. A list of the Points of Contact (POC's) for the site visits scheduled for May 1988 is shown in Enclosure 4. An updated list of POC's will be prepared and mailed to the appropriate MSC's as visitation dates and arrangements are confirmed.

FOR THE COMMANDER:

Walter Roy
WALTER N. ROY
MTT Program Manager

DISTRIBUTION LIST

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2800 Powder Mill Road
Adelphi, MD 20783-1197

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Harry Diamond Laboratories
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ATTN: SDSCC-Q, Mr. D. L. Ross
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FY1988 AMC TESTING NEEDS SURVEY
BACKGROUND INFORMATION

PURPOSE

The AMC Deputy Chief of Staff for Product Assurance and Test, Mr. S. J. Lorber, has tasked the Army Materials Technology Laboratory (MTL) as manager of the MTT Program with the responsibility for conducting an in-depth survey of AMC's testing needs. The purpose of this survey is to provide a planning matrix and five year plan for the formulation, prioritization, and funding of projects within the MTT Program. Through this survey an estimate will be developed for the amount of resources required to address the testing needs of emerging materials and notional systems. A similar survey was conducted by MTL for AMC in 1975. That survey filled a major need at the time, and provided an earlier planning matrix that led to the scheduling and successful conclusion of many critical testing needs projects.

SCOPE

The survey is intended to identify and describe material testing needs throughout all phases of the materiel life cycle for all systems, items, and components in or scheduled for the Army inventory. Particular emphasis should be given to the planned increased use of emerging materials i.e. ceramics, composites, polymers, etc. in notional systems. Also of concern are requirements to evaluate the remaining life of components which are scheduled for routine replacement or evaluation during maintenance or rebuild operations. In the past, programs have been funded to satisfy testing need requirements during each phase of a material life cycle. Several examples of different programs follow to illustrate the variety of potential needs to be addressed.

Production - Monitor/evaluate quality parameters/characteristics
- Process feedback and control

In Service - Insitu monitors for stresses and fatigue

Overhaul - Dynamic testing of engine components
- In process monitoring of welding process

Storage - Surveillance inspection method to monitor deterioration of propellant/explosive materials

TESTING NEEDS

a. On-Site Reviews. In response to the requirements of this task, a series of on-site reviews has been scheduled at AMC Major Subordinate Commands (MSC's) during the next several months of the current fiscal year (1988). The MSC's have been requested to provide in-depth briefings on each identified testing need including any associated specifications, standards, drawings, visual aids, or other pertinent exhibits. Each Command was also requested to assure the representation and participation at these reviews of Program/Project Managers within or associated with their Commands.

b. Survey Team. The MTL survey team membership can and will probably vary with each visit, but will generally consist of the Materials Testing Technology (MTT) Program liaison or a responsible representative of MTL, and a representative of the Nondestructive Testing Information Analysis Center (NTIAC). NTIAC has been contracted to assist MTL in adminstering this survey.

c. Information Required.

(1) To facilitate the identification and categorizing of testing needs, there is attached hereto a general list of the types of information that should be considered and reported with each testing need. The list is only a guide and should not be considered restrictive.

(2) In even more general terms the type of information required for this survey can be summarized in the form of questions as follow:

(a) Where in the materiel life cycle is the need?

(b) Is the need associated with a system (program/project managed) or does it have broad potential for application to many systems?

(c) Is the need specific to a material or process?

(d) What are the current requirements and/or QA procedures?

(e) What are the potential benefits? (Return on Investment, Reliability, Availability, Maintainability, etc.)

(f) Is the need immediate or anticipated?

(g) Is there a proposed solution?

(h) What is the testing technology? (Nondestructive Testing (NDT), Mechanical, Chemical, Electronics/Software, or combination?)

The above questions have merely been listed to indicate the types of questions that can be asked in any reasonable approach to help in identifying testing needs in context. These questions should not be considered exclusive.

SUMMARY

The foregoing provides only a broad background and overview of the testing needs planning matrix. It can be seen that this survey is an ambitious undertaking and will require the fullest cooperation and participation of all elements of the AMC community. With such cooperation and participation, the results of this effort should provide an effective program planning guide appropriate for both near and far term goals.

AMC TESTING NEEDS SURVEY - CATEGORIES OF INFORMATION

A. COMMODITY

1. Aircraft
2. Missiles
3. Weapons
4. Tracked Combat Vehicles
5. Ammunition
6. Tactical and Support Vehicles
7. Communications and Electronic Equipment
8. Other Support Equipment

B. MATERIALS

1. Metals
2. Ceramics
3. Composites
4. Polymers

C. TESTING NEED APPLICABLE TO

1. System (N/A)
2. Prime Item
3. Critical Item
4. Non-Complex Item
5. Inventory Item
6. Process
7. Material
8. Computer Program
9. Other (Specify)

D. TEST ENGINEERING CRITERIA

1. Performance
2. Reliability
3. Maintainability
4. Environmental
5. Transportability
6. Quality
7. Safety
8. Human Performance/Engineering
9. Process Control
10. Procedures and Operations
11. Identification and Marking
12. Physical Characteristics
13. Computer Memory Requirements
14. Tribology
15. Other (Specify)

(* One or more of these criteria may be applicable to the testing need for the item identified in B. above.)

E. TESTING TECHNOLOGY

1. Chemical
2. Mechanical
3. Nondestructive
4. Electronics/Software

CHEMICAL TESTING

This category encompasses projects where the solution to an Army problem involves the determination of the quality of materials by classical volumetric, or gravimetric techniques as well as chromatographic, spectroscopic, thermal, radioanalytical, electroanalytical, spectrometric, and other methods of chemical analysis. Projects evaluated by this subgroup should be limited to those which propose a chemical test, rather than all those which address chemical items.

MECHANICAL TESTING

This category encompasses projects where the solution to an Army problem involves the scientific evaluation of the technical requirements for materials/materiel in terms of those properties that stem from elastic and inelastic response to an applied load, possibly involving a relationship between stress and strain. Such properties include, but are not necessarily limited to, toughness, hardness, tensile, shear, elongation, vibration, shock, etc.

NONDESTRUCTIVE TESTING

This category encompasses projects where the solution to an Army problem would employ either (a) traditional NDT (i.e., radiography, magnetic particle, liquid penetrant, ultrasonics, eddy current, and infrared), or (b) other emerging methodologies which are nondestructive for testing applications. (A nondestructive test is one that does not prevent use of the item tested for its intended application.) Specifically excluded are projects where the Army problem concerns the functional characteristics of electronic devices (systems, subsystems, or components) or computers (hardware) and computer programs (software). This exclusion does not apply to electronic materials.

ELECTRONIC/SOFTWARE TESTING

This category encompasses projects where the Army problem concerns the performance characteristics of electronic devices (systems, subsystems, or components) or computers (hardware) and computer programs (software). In general, solutions to these problems are nondestructive in nature although the category does accommodate destructive tests. This category does not include electronic materials.

AMC TESTING NEEDS SURVEY POINTS-OF-CONTACT

Command	Location	Name	Phone/Autovon
AMCCOM/ARDEC	Dover, NJ Picatinny	Jim Sewell	(201) 724-5364 AV 880-5364
AMCCOM/CRDEC	Aberdeen, MD Edgewood	Tom Potite	(301) 671-4321 AV 584-4321
AMCCOM/WVT	Watervliet, NY	Ken Insco & Carol Liu	(518) 271-4784 AV 974-4784
AVSCOM	St. Louis, MO	A. Spratt	(314) 263-1762 AV 693-1762
CECOM	Ft. Monmouth, NJ	Bing Bui	(201) 532-3442/9 AV 992-3442/9
DESCOM	Chambersburg, PA	Joe Byers	(717) 267-9126 AV 570-9126
DESCOM/CCAD	Corpus Christi, TX	Dan Ross Charles Wilson	(512) 939-3871 AV 861-3871
DESCOM/LTRK	Chambersburg, PA Letterkenny Dep.	Glenn Mantooth	(717) 267-8084 AV 570-8084
DESCOM/RRAD	Texarkana, TX Red River Dep.	W. D. Wuertz	(214) 838-2151 AV 829-2151
LABCOM	Adelphi, MD	Steven Doherty	(202) 394-3330 AV 290-3330
LABCOM/ETDL	Ft. Monmouth, NJ	Joe Key	(201) 544-4258 AV 995-4258
LABCOM/HDL	Adelphi, MD Harry Diamond Lab	Julius Hoke	(202) 394-1551 AV 290-1551
LABCOM/MTL	Watertown, MA Matl. Tech. Lab	Walter Roy Fred Stenton	(617) 923-5333/43 AV 955-5333/43
MICOM	Huntsville, AL	D. Dunston	(205) 876-2147 AV 746-2147
TACOM	Warren, MI	Chester Kedzior	(313) 574-8037/8/9 AV 786-8037/8/9

AMC TESTING NEEDS SURVEY POINTS-OF-CONTACT (CONT'D)

Command	Location	Name	Phone/Autovon
TECOM	Aberdeen, MD Edgewood	Jim Piro	(301) 278-2170 AV 298-2170
TROSCOM	Natick, MA (NRDEC)	Don McLeod	(617) 651-4883 AV 256-4883

MTT PROGRAM AND TESTING NEEDS SURVEY COORDINATORS

Command	Location	Name	Phone/Autovon
MTL (MTT Program and Survey)	Watertown, MA Matl. Tech. Lab	Walter Roy Fred Stenton Roger Lamothe	(617) 923-5333/43 AV 955-5333/43
NTIAC (Survey)	San Antonio, TX Sw. Res. Inst.	Frank Iddings Richard Cervantes	(512) 522-2737 (512) 522-2481

APPENDIX C

MATERIALS TESTING NEEDS SURVEY SUBMISSIONS

APPENDIX C - TABLE OF CONTENTS

APPENDIX C.1

TESTING NEEDS SUBMISSIONS FORM NUMBER/TITLE INDEX

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
1	TITLE : COMPOSITE MATERIAL EVALUATION COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	AIRCRAFT COMPOSITES NDE APACHE BLACKHAWK ULTRASONICS THERMOGRAPHY RADIOGRAPHY
2	TITLE : NDE OF ADHESIVELY BONDED JOINTS COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	ADHESIVES BONDS AIRCRAFT NDE COMPOSITES CERAMICS METALS JOINTS
3	TITLE : MECHANICAL TESTING AND NDE OF AIRCRAFT COMPONENTS FOR HYDROGEN EMBRITTLEMENT COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	HYDROGEN DAMAGE ENGINES AIRCRAFT STEEL NDE MECHANICAL MATERIALS COMPONENTS
4	TITLE : MONITORING OF CADMIUM AND OTHER PLATING PROCESSES COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	PLATING PROCESS CONTROL CHEMICAL MONITOR NDE AIRCRAFT CADMIUM CHROMIUM PLATING SOLUTION
5	TITLE : DETECTION OF MAIN ROTOR BLADE DEBONDING COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	ROTOR BLADES AIRCRAFT ADHESIVE BONDS DEBONDING NDE WATER INTRUSION NONE NONE
6	TITLE : TESTING METHODS FOR GLASS AND PLASTIC PANELS COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	GLASS PLASTICS WINDOW PANELS FLOOR PANELS OPTICAL TESTING MECHANICAL NDE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
7	TITLE : DETERMINATION OF CRITICAL BLISTERING OF BLADDER TANKS COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	BLADDER TANKS FUEL TANKS BLISTERING AIRCRAFT FUEL NDE ELASTOMERS STORAGE
8	TITLE : LEAK DETECTION IN FUEL SYSTEMS COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	AIRCRAFT FUEL LEAKS FUEL STORAGE AIRFRAME CORROSION CHEMICAL TESTING NDE NONE
9	TITLE : QUALITY CONTROL AND TESTING OF AIRCRAFT OILS AND LUBRICANTS COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	AIRCRAFT OILS LUBRICANTS ENGINES QUALITY CONTROL CHEMICAL TESTING NDE WEAR
10	TITLE : MONITORING, DETECTION, AND DISPOSAL OF HAZARDOUS WASTES COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : G. WILSON COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	HAZARDOUS WASTES WASTE MANAGEMENT WASTE STORAGE DISPOSAL CHEMICAL TESTING NDE WASTE MONITORING NONE
11	TITLE : PART MARKING AND IDENTIFICATION COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : D. ROSS COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	MARKINGS PART IDENTIFICAT PARTS CONTROL LASER MARKING TAGGING IMBEDDED MICROELECTRONICS NONE
12	TITLE : CORROSION DETECTION FOR AIRFRAME AND AIRCRAFT COMPONENTS COMMAND : DESCOM INSTAL'N : CCAD PRESENTER : D. ROSS COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	CORROSION AIRCRAFT AIRFRAME CHEMICAL TESTING NDE NONE NONE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
13	TITLE : QUANTITATIVE DETERMINATION OF GRINDING BURN ON METALS	GRINDING BURN METALS
	COMMAND : DESCOM INSTAL'N : CCAD	DETECTION
	PRESENTER : G. WILSON COST($K) : 0	COMPONENTS
	TESTING TECHNOLOGIES :	AIRCRAFT
	CHEMICAL	ENGINES
	NONDESTRUCTIVE	NDE CHEMICAL
14	TITLE : WELD PROCESS MONITORING AND CONTROL	WELDING PROCESS MONITOR
	COMMAND : DESCOM INSTAL'N : CCAD	PROCESS CONTROL
	PRESENTER : G. WILSON COST($K) : 0	NDE
	TESTING TECHNOLOGIES :	IMAGING OPTICAL
	NONDESTRUCTIVE	AIRCRAFT MAINTENANCE
15	TITLE : AUTOMATIC TEST EQUIPMENT (ATE) FOR ENGINE OVERHAUL	ENGINES OVERHAUL
	COMMAND : DESCOM INSTAL'N : RRAD	ATE
	PRESENTER : B. WUERTZ COST($K) : 0	DIMENSIONAL MEASUREM
	TESTING TECHNOLOGIES :	TRANSMISSIONS
	MECHANICAL	MECHANICAL
	ELECT / SOFTWARE	NONE NONE
16	TITLE : NDE OF ROCKET MOTORS AND PROPELLANTS	ROCKET MOTORS PROPELLANTS
	COMMAND : DESCOM INSTAL'N : RRAD	NDE
	PRESENTER : B. WUERTZ COST($K) : 0	DELAMINATION
	TESTING TECHNOLOGIES :	VOIDS RADIOGRAPHY
	NONDESTRUCTIVE	ULTRASONICS DAMAGE
17	TITLE : AUTOMATED EVALUATION OF PLATINGS AND PLATING PROCESSES	PLATING PROCESS CONTROL
	COMMAND : DESCOM INSTAL'N : RRAD	MONITORING
	PRESENTER : B. WUERTZ COST($K) : 0	MEASUREMENT
	TESTING TECHNOLOGIES :	GUN TUBES
	CHEMICAL	ENGINES
	NONDESTRUCTIVE	AIRCRAFT CHEMICAL TESTING
18	TITLE : AUTOMATED NONDESTRUCTIVE EVALUATION OF GUN TUBES	GUN TUBES NDE
	COMMAND : DESCOM INSTAL'N : RRAD	AUTOMATED
	PRESENTER : B. WUERTZ COST($K) : 0	WEAR
	TESTING TECHNOLOGIES :	CORROSION MEASUREMENT
	NONDESTRUCTIVE ELECT / SOFTWARE	VISION SYSTEM INSPECTION

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
19	TITLE : IN-SITU ANALYSIS OF OIL/LUBRICANT QUALITY	OILS LUBRICANTS
	COMMAND : DESCOM INSTAL'N : RRAD	QUALITY CONTROL
	PRESENTER : B. WUERTZ COST($K) : 0	ENGINES
	TESTING TECHNOLOGIES :	TRANSMISSIONS
	CHEMICAL	MONITORING
	NONDESTRUCTIVE	CHEMICAL TESTING NDE
20	TITLE : NDE OF ADHESIVELY BONDED JOINTS	ADHESIVE BONDS NDE
	COMMAND : DESCOM INSTAL'N : RRAD	PATRIOT
	PRESENTER : B. WUERTZ COST($K) : 0	MISSILES
	TESTING TECHNOLOGIES :	AIRCRAFT
		VEHICLES
	NONDESTRUCTIVE	TRACK PADS
		COMPOSITES
21	TITLE : DETERMINATION OF METAL FATIGUE AND REMAINING LIFE	FATIGUE METALS
	COMMAND : DESCOM INSTAL'N : RRAD	DETECTION
	PRESENTER : B. WUERTZ COST($K) : 0	REMAINING LIFE
	TESTING TECHNOLOGIES :	GUN TUBES
	MECHANICAL	VEHICLES
	NONDESTRUCTIVE	AIRFRAME
		NONE
22	TITLE : NDE OF BOLTS	BOLTS QUALITY CONTROL
	COMMAND : DESCOM INSTAL'N : RRAD	NDE
	PRESENTER : B. WUERTZ COST($K) : 0	MATERIALS
	TESTING TECHNOLOGIES :	CRACKING
		STRESS
	NONDESTRUCTIVE	NONE
		NONE
23	TITLE : IN-PROCESS WELDING MONITORING	WELDING PROCESS
	COMMAND : DESCOM INSTAL'N : RRAD	MONITORING
	PRESENTER : B. WUERTZ COST($K) : 0	CONTROL
	TESTING TECHNOLOGIES :	NDE
		INFRARED
	NONDESTRUCTIVE ELECT / SOFTWARE	TRACKED VEHICLES
		MISSILE CARRIERS
24	TITLE : CORROSION DETECTION AND MEASUREMENT	CORROSION DETECTION
	COMMAND : DESCOM INSTAL'N : RRAD	MEASUREMENT
	PRESENTER : B. WUERTZ COST($K) : 0	MUNITIONS
	TESTING TECHNOLOGIES :	TRACKED VEHICLES
		WEAPONS
	NONDESTRUCTIVE	NDE
		NONE

APPENDIX C.2

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
19	TITLE : IN-SITU ANALYSIS OF OIL/LUBRICANT QUALITY	OILS LUBRICANTS
	COMMAND : DESCOM INSTAL'N : RRAD	QUALITY CONTROL
	PRESENTER : B. WUERTZ COST($K) : 0	ENGINES
	TESTING TECHNOLOGIES :	TRANSMISSIONS
	CHEMICAL	MONITORING
	NONDESTRUCTIVE	CHEMICAL TESTING NDE
20	TITLE : NDE OF ADHESIVELY BONDED JOINTS	ADHESIVE BONDS NDE
	COMMAND : DESCOM INSTAL'N : RRAD	PATRIOT
	PRESENTER : B. WUERTZ COST($K) : 0	MISSILES
	TESTING TECHNOLOGIES :	AIRCRAFT VEHICLES
	NONDESTRUCTIVE	TRACK PADS COMPOSITES
21	TITLE : DETERMINATION OF METAL FATIGUE AND REMAINING LIFE	FATIGUE METALS
	COMMAND : DESCOM INSTAL'N : RRAD	DETECTION
	PRESENTER : B. WUERTZ COST($K) : 0	REMAINING LIFE
	TESTING TECHNOLOGIES :	GUN TUBES
	MECHANICAL	VEHICLES
	NONDESTRUCTIVE	AIRFRAME NONE
22	TITLE : NDE OF BOLTS	BOLTS QUALITY CONTROL
	COMMAND : DESCOM INSTAL'N : RRAD	NDE
	PRESENTER : B. WUERTZ COST($K) : 0	MATERIALS
	TESTING TECHNOLOGIES :	CRACKING STRESS
	NONDESTRUCTIVE	NONE NONE
23	TITLE : IN-PROCESS WELDING MONITORING	WELDING PROCESS
	COMMAND : DESCOM INSTAL'N : RRAD	MONITORING
	PRESENTER : B. WUERTZ COST($K) : 0	CONTROL
	TESTING TECHNOLOGIES :	NDE INFRARED
	NONDESTRUCTIVE ELECT / SOFTWARE	TRACKED VEHICLES MISSILE CARRIERS
24	TITLE : CORROSION DETECTION AND MEASUREMENT	CORROSION DETECTION
	COMMAND : DESCOM INSTAL'N : RRAD	MEASUREMENT
	PRESENTER : B. WUERTZ COST($K) : 0	MUNITIONS
	TESTING TECHNOLOGIES :	TRACKED VEHICLES WEAPONS
	NONDESTRUCTIVE	NDE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
25	TITLE : WEAR OF GUN TUBES DUE TO THE BALLOTING EFFECT COMMAND : LABCOM INSTAL'N : HDL PRESENTER : A. FREYDMAN COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	GUN TUBES WEAR BALLOTING EFFECT NDE OPTICAL FUZES PROJECTILES NONE
26	TITLE : MEASUREMENT OF PROJECTILL VIBRATION/SHOCK IN GUN TUBES COMMAND : LABCOM INSTAL'N : HDL PRESENTER : A. FREYDMAN COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	FUZES PROJECTILES VIBRATION SHOCK NDE OPTICAL GUN TUBES HISTORY
27	TITLE : MEASUREMENT OF INTERNAL RESPONSE ENVIRONMENT OF MISSILES COMMAND : LABCOM INSTAL'N : HDL PRESENTER : A. FREYDMAN COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	MISSILES ELECTRONICS VIBRATION SHOCK NDE OPTICAL TELEMETRY HISTORY
28	TITLE : DEVELOPMENT OF MULTI-AXIS PRODUCTION SCREENING TESTS COMMAND : LABCOM INSTAL'N : HDL PRESENTER : A. FREYDMAN COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	VIBRATION SHOCK PRODUCTION SCREENING MULTI-AXIS SHAKERS FAILURE NONE NONE
29	TITLE : MODELING OF HIGH-G EFFECTS FOR WEAPONS AND MUNITIONS COMMAND : LABCOM INSTAL'N : HDL PRESENTER : A. FREYDMAN COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE BALLISTIC	MODELING SOFTWARE COMPUTER HIGH G EVENTS BALLISTICS IMPACT ARMOR SHOCK EVENTS
30	TITLE : TESTING OF HIGH-G EFFECTS FOR WEAPONS AND ARMORS COMMAND : LABCOM INSTAL'N : HDL PRESENTER : A. FREYDMAN COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	BALLISTICS HIGH G EVENTS AIR GUNS HIGH ENERGY WEAPONS MITIGATORS RAIL GUNS WEAPONS SHOCK EVENTS

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
31	TITLE : CONTINUOUS MEASUREMENT OF VELOCITY AND MOTION IN BALLISTIC AND VIBRATION TESTING COMMAND : LABCOM INSTAL'N : HDL PRESENTER : J. HOKE COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	BALLISTICS VELOCITY MOTION CONTINUOUS MEASUREME ARMOR PENETRATORS NDE LASER INTERFEROMETRY
32	TITLE : MECHANICAL TESTING OF SOLDER JOINTS COMMAND : LABCOM INSTAL'N : HDL PRESENTER : J. HOKE COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	SOLDER JOINTS ELECTRONICS MICROELECTRONICS MECHANICAL VIBRATION SHAKERS FAILURE NONE
33	TITLE : MODELING SOFTWARE FOR SOLDER JOINTS COMMAND : LABCOM INSTAL'N : HDL PRESENTER : J. HOKE COST($K) : 0 TESTING TECHNOLOGIES : ELECT / SOFTWARE	MODELING SOLDER JOINTS ELECTRONICS DESIGN SIMULATION SOFTWARE COMPUTER NONE
34	TITLE : NDE OF SOLDER JOINTS AND CIRCUIT SUBASSEMBLIES COMMAND : LABCOM INSTAL'N : HDL PRESENTER : J. HOKE COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	SOLDER JOINTS CIRCUIT BOARDS ELECTRONICS NDE X-RAY IMAGING INSPECTION AUTOMATED
35	TITLE : TESTING AND EVALUATION OF MODELING AND SIMULATION SOFTWARE COMMAND : LABCOM INSTAL'N : HDL PRESENTER : J. HOKE COST($K) : 0 TESTING TECHNOLOGIES : ELECT / SOFTWARE	SOFTWARE MODELING SIMULATION COMPUTER EXPERT SYSTEMS ARTIFICIAL INTEL PROGRAMMING EVALUATION
36	TITLE : SOFTWARE DEVELOPMENT FOR ARTIFICIALLY INTELLIGENT TARGET ACQUISITION COMMAND : LABCOM INSTAL'N : HDL PRESENTER : J. HOKE COST($K) : 0 TESTING TECHNOLOGIES : ELECT / SOFTWARE	SOFTWARE EXPERT SYSTEMS ARTIFICIAL INTEL COMPUTER TARGETS ACQUISITION IDENTIFICATION PROGRAMMING

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
37	TITLE : ACCEPTANCE TESTING OF COMPOSITES AND NON-METALLICS COMMAND : TECOM INSTAL'N : APG PRESENTER : G. SHELTON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	COMPOSITES NON-METALLICS VEHICLES TRACKED COMBAT NDE THERMOGRAPHY RADIOGRAPHY ULTRASONICS
38	TITLE : EFFECTIVENESS TESTING OF ELECTROMAGNETIC SHIELDING COMMAND : TECOM INSTAL'N : APG PRESENTER : G. SHELTON COST($K) : 0 TESTING TECHNOLOGIES : ELECT / SOFTWARE	SHIELDING ELECTROMAGNETICS SIMULATOR MATERIALS TESTING RADIATION EQUIPMENT ELECTRONICS
39	TITLE : SIMULATION OF INFRARED TARGETS COMMAND : TECOM INSTAL'N : APG PRESENTER : W. MILLWAY COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	INFRARED RADIATION TARGETS SIGNATURES ACQUISITION SIMULATION DETECTION EQUIPMENT
40	TITLE : DETERMINATION OF THE ELECTROMAGNETIC SUSCEPTIBILITY OF OILS AND LUBRICANTS COMMAND : TECOM INSTAL'N : APG PRESENTER : J. PIRO COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL ELECT / SOFTWARE	LUBRICANTS OILS ELECTROMAGNETICS RADIATION SUSCEPTIBILITY ENGINES TRANSMISSIONS CHEMICAL
41	TITLE : EFFECTS OF CHEMICAL AGENTS ON MATERIALS, COATINGS, AND ADHESIVES COMMAND : TECOM INSTAL'N : APG PRESENTER : J. PIRO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL CHEMICAL	CHEMICAL AGENTS CONTAMINATION DECONTAMINATION SUSCEPTIBILITY COMPOSITES ADHESIVE BONDS OPTICAL COATINGS MATERIALS
42	TITLE : PERFORMANCE TESTING/MEASUREMENT OF SMOKES AND OBSCURANTS COMMAND : TECOM INSTAL'N : APG PRESENTER : J. PIRO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL CHEMICAL	SMOKE OBSCURANTS TESTING MEASUREMENT COVERAGE LIGHT SCATTERING DENSITY LASER

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
43	TITLE : SOIL TESING FOR CHEMICAL AGENT CONTAMINATION COMMAND : TECOM INSTAL'N : APG PRESENTER : J. PIRO COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL	CHEMICAL AGENTS CONTAMINATION DECONTAMINATION FIELD SAMPLING KIT SOIL VEGITATION NONE
44	TITLE : ENVIRONMENTAL TESTING OF LAMINATES COMMAND : TECOM INSTAL'N : APG PRESENTER : F. MABANTA COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	PLASTICS ACRYLICS LAMINATES ENVIRONMENTAL AGING DETERIORATION NDE MECHANICAL
45	TITLE : DELELOPMENT OF SIGNATURE MASKING MATERIALS COMMAND : TECOM INSTAL'N : APG PRESENTER : F. MABANTA COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL CHEMICAL	INFRARED ELECTROMAGNETICS TARGETS SIGNATURE MASKING MATERIALS LOW OBSERVABLES MILLIMETER WAVE MICROWAVE
46	TITLE : LIQUID (CHEMICAL) AGENT DETECTOR COMMAND : CRDEC INSTAL'N : EDGEWOOD PRESENTER : H. ELBAUM COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL	CHEMICAL AGENTS DETECTION LIQUID AGENTS DETECTOR FIELD SAMPLING DROPLET SIZE COLOR NONE
47	TITLE : BUTYL COAT CLOTH AND MATERIAL TESTING COMMAND : CRDEC INSTAL'N : EDGEWOOD PRESENTER : H. ELBAUM COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL	CHEMICAL AGENTS PROTECTION CLOTHING MATERIALS BUTYL COAT PERMEATION NONE NONE
48	TITLE : TEST METHOD TO EVALUATE FILTER AND CHARCOAL EFFECTIVENESS COMMAND : CRDEC INSTAL'N : EDGEWOOD PRESENTER : H. ELBAUM COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	CHEMICAL AGENTS FILTERS MASKS CHARCOAL MATERIALS EFFECTIVENESS TEST INSTRUMENT NONE

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
49	TITLE : DEVELOPMENT OF CHEMICAL AGENT SIMULANTS	CHEMICAL AGENTS SIMULANTS
	COMMAND : CRDEC INSTAL'N : EDGEWOOD	PROTECTION
	PRESENTER : H. ELBAUM COST($K) : 0	CHEMICAL TESTING
	TESTING TECHNOLOGIES :	HAZARDOUS WASTES
	CHEMICAL	NEUTRALIZATION
		NONE
		NONE
50	TITLE : METHODS FOR THE REDUCTION OF HAZARDOUS WASTES	HAZARDOUS WASTES WASTE MANAGEMENT
	COMMAND : CRDEC INSTAL'N : EDGEWOOD	REDUCTION
	PRESENTER : H. ELBAUM COST($K) : 0	NEUTRALIZATION
	TESTING TECHNOLOGIES :	CHEMICAL AGENTS
	CHEMICAL	NONE
		NONE
		NONE
51	TITLE : DEVELOPMENT OF "FULLERS EARTH" EQUIVALENT MATERIAL	FULLERS EARTH CHEMICAL TESTING
	COMMAND : CRDEC INSTAL'N : EDGEWOOD	ABSORBANT
	PRESENTER : H. ELBAUM COST($K) : 0	EQUIVALENT MATERIAL
	TESTING TECHNOLOGIES :	NONE
	CHEMICAL	NONE
		NONE
		NONE
52	TITLE : DEVELOPMENT AND TESTING OF CHEMICAL AGENT RESISTANT PAINTS	PAINTS COATINGS
	COMMAND : CRDEC INSTAL'N : EDGEWOOD	CHEMICAL AGENTS
	PRESENTER : H. ELBAUM COST($K) : 0	RESISTANCE
	TESTING TECHNOLOGIES :	ABSORPTION
	CHEMICAL	VEHICLES
		AIRCRAFT
		EQUIPMENT
53	TITLE : GAS PHASE LEAKAGE TESTER	GAS MASKS M14 MASK
	COMMAND : CRDEC INSTAL'N : EDGEWOOD	GAS PHASE
	PRESENTER : L. FRIEDMAN COST($K) : 0	TESTING
	TESTING TECHNOLOGIES :	AUTOMATED
	CHEMICAL	HEADFORM
	NONDESTRUCTIVE	LIGHT SCATTERING
		AEROSOL
54	TITLE : DEVELOPMENT OF MUNITIONS TO DEFEAT IR AND MILLIMETER WAVE	MUNITIONS INFRARED
	COMMAND : CRDEC INSTAL'N : EDGEWOOD	MILLIMETER WAVE
	PRESENTER : D. MATTS COST($K) : 0	MM WAVE
	TESTING TECHNOLOGIES :	ABSORPTION
	MECHANICAL CHEMICAL	VEHICLES
		AIRCRAFT
		OBSCURANTS

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
55	TITLE : TESTING AND INSPECTION OF 300 GAL. FUEL TANKS	FUEL TANKS LEAK DETECTION
	COMMAND : DESCOM — INSTAL'N : LTRK	INSPECTION
	PRESENTER : G. MANTOOTH — COST($K) : 0	AUTOMATED
	TESTING TECHNOLOGIES :	NDE
	MECHANICAL	ACOUSTIC EMISSION
	NONDESTRUCTIVE	NONE
		NONE
56	TITLE : AUTOMATED INSPECTION OF GUN TUBES	GUN TUBES INSPECTION
	COMMAND : DESCOM — INSTAL'N : LTRK	AUTOMATED
	PRESENTER : G. MANTOOTH — COST($K) : 0	NDE
	TESTING TECHNOLOGIES :	VISION SYSTEM
	MECHANICAL	CORROSION
	NONDESTRUCTIVE	WEAR
		PLATING
57	TITLE : REMAINING LIFE DETERMINATION OF ELECTRONIC COMPONENTS AND SUBASSEMBLIES	ELECTRONICS REMAINING LIFE
	COMMAND : DESCOM — INSTAL'N : LTRK	DIAGNOSTICS
	PRESENTER : G. MANTOOTH — COST($K) : 0	COMPONENTS
	TESTING TECHNOLOGIES :	SUBASSEMBLIES
		NDE
	NONDESTRUCTIVE — ELECT / SOFTWARE	AUTOMATED
		SELF-TESTING
58	TITLE : TERMINAL VELOCITY AND RECOIL MEASUREMENT TECHNIQUES	BALLISTICS VELOCITY
	COMMAND : DESCOM — INSTAL'N : LTRK	MOTION
	PRESENTER : G. MANTOOTH — COST($K) : 0	MEASUREMENT
	TESTING TECHNOLOGIES :	ARMOR
	MECHANICAL	PENETRATORS
	NONDESTRUCTIVE	NDE
		LASER INTERFEROMETRY
59	TITLE : AUTONATED WELD INSPPECION	WELDS INSPECTION
	COMMAND : DESCOM — INSTAL'N : LTRK	AUTOMATED
	PRESENTER : W. WHITE — COST($K) : 0	NDE
	TESTING TECHNOLOGIES :	REPAIRS
		VEHICLES
	NONDESTRUCTIVE	COMBAT
		NONE
60	TITLE : NDE OF SOLDER JOINTS AND CIRCUIT SUBASSEMBLIES	SOLDER JOINTS ELECTRONICS
	COMMAND : DESCOM — INSTAL'N : LTRK	NDE
	PRESENTER : W. SIPES — COST($K) : 0	HAWK MISSILE
	TESTING TECHNOLOGIES :	X-RAY
		IMAGING
	NONDESTRUCTIVE	INSPECTION
		AUTOMATED

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
61	TITLE : TEST METHODS TO DETERMINE WEAR ON GEARS AND GEAR MECHANISMS	GEARS WEAR
	COMMAND : DESCOM — INSTAL'N : LTRK	NDE
	PRESENTER : W. SIPES — COST($K) : 0	INSPECTION
	TESTING TECHNOLOGIES :	CONTROL
	MECHANICAL	OPTICAL
	NONDESTRUCTIVE	AUTOMATED
		MECHANISMS
62	TITLE : THICKNESS DETERMINATION OF CONFORMAL COATINGS	COATINGS CONFORMAL
	COMMAND : DESCOM — INSTAL'N : LTRK	ELECTRONICS
	PRESENTER : W. SIPES — COST($K) : 0	CIRCUIT BOARDS
	TESTING TECHNOLOGIES :	THICKNESS
	MECHANICAL	MEASUREMENT
	NONDESTRUCTIVE	NDE
		NONE
63	TITLE : TEST METHODS TO DETERMINE SHELF LIFE OF PAINTS, ADHESIVES, SEALANTS, COATINGS	PAINTS COATINGS
	COMMAND : DESCOM — INSTAL'N : LTRK	SEALANTS
	PRESENTER : W. SIPES — COST($K) : 0	ADHESIVES
	TESTING TECHNOLOGIES :	SHELF LIFE
	CHEMICAL	CHEMICAL TESTING
		NONE
		NONE
64	TITLE : TEST METHODS TO MONITOR BEARING QUALITY	BEARINGS QUALITY
	COMMAND : DESCOM — INSTAL'N : LTRK	MONITORING
	PRESENTER : W. SIPES — COST($K) : 0	NDE
	TESTING TECHNOLOGIES :	INSPECTION
	MECHANICAL	ENGINES
	NONDESTRUCTIVE	TRANSMISSIONS
		AIRCRAFT
65	TITLE : TEST METHODS TO DETERIMINE OIL AND LUBRICANT QUALITY	OILS LUBRICANTS
	COMMAND : DESCOM — INSTAL'N : LTRK	QUALITY
	PRESENTER : R. GLICK — COST($K) : 0	MONITORING
	TESTING TECHNOLOGIES :	CHEMICAL TESTING
	CHEMICAL	NDE
	NONDESTRUCTIVE	ENGINES
		WEAR
66	TITLE : IN-PROCESS MONITORING OF PLATINGS AND PLATING PROCESSES	PLATING PROCESS CONTROL
	COMMAND : DESCOM — INSTAL'N : LTRK	THICKNESS
	PRESENTER : R. GLICK — COST($K) : 0	ADHESION
	TESTING TECHNOLOGIES :	NDE
	CHEMICAL	ENGINES
	NONDESTRUCTIVE	CHROMIUM
		PHOSPHATE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
67	TITLE : TEST METHODS TO DETERMINE THE QUALITY OF ADHESIVES AND ADHESIVE JOINTS COMMAND : DESCOM INSTAL'N : LTRK PRESENTER : R. GLICK COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	ADHESIVES BONDS QUALITY NDE COMPOSITES FAILURE JOINTS NONE
68	TITLE : TEST METHODS FOR CORROSION DETECTION AND ASSESSMENT COMMAND : DESCOM INSTAL'N : LTRK PRESENTER : R. GLICK COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	CORROSION DETECTION NDE DAMAGE ENGINES VEHICLES AIRCRAFT ASSESSMENT
69	TITLE : FIELD BORE MEASUREMENT SYSTEM COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : K. INSCO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	CANNONS GUN TUBES BORE MEASUREMENT STAR GAGES GROOVES DIAMETER NONE
70	TITLE : SMALL CALIBER INSPECTION SYSTEM COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : K. INSCO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	GUN TUBES MORTARS SMALL CALIBER INSPECTION STATION COORDINATE MEASURING MACHINE NONE
71	TITLE : LASER INSPECTION OF RECOIL KEYWAY COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : K. INSCO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	HOWITZER KEYWAYS INSPECTION STRAIGHTNESS RECOIL LASER GUN TUBES NONE
72	TITLE : INSPECTION OF OBTURATOR PADS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : K. INSCO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	PADS OBTURATOR INSPECTION VISION SYSTEM DEFORMATION HOWITZER BREACH SEAL SPINDLE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
73	TITLE : BASE PLATE SIMULATOR COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : K. INSCO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	BASE PLATES MORTARS PROOF FIRING TESTING SIMULATOR PRESSURE IMPACT INSPECTION
74	TITLE : TENSILE AND CHARPY TEST EQUIPMENT COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : K. INSCO COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	TENSILE CHARPY EQUIPMENT MATERIALS AUTOMATED FORGING GUN TUBES NONE
75	TITLE : COMPUTERIZED INDUSTRIAL TOMOGRAPHY SCANNER COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : M. SMULSKY COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	RADIOGRAPHY TOMOGRAPHY COMPUTERIZED INDUSTRIAL MATERIALS GUN TUBES INSPECTION FORGING
76	TITLE : ACOUSTO-ULTRASONIC INSPECTION OF COMPOSITES COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	COMPOSITES INSPECTION ACOUSTO-ULTRASONICS LAUNCHER EVACUATOR DEFECTS NDE NONE
77	TITLE : ON-LINE CHEMICAL ANALYSIS OF METAL FINISHING SOLUTIONS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. FRIAR COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL	PLATING PROCESS MONITOR PROCESS CONTROL GUN TUBES AUTOMATED CHEMICAL MONITOR NONE NONE
78	TITLE : ESTABLISHMENT OF GUIDELINES FOR NDT OF COMPOSITE MATERIALS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : E. TROIANO COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	COMPOSITES NDE EVACUATOR INSPECTION DEFECTS ULTRASONICS X-RAY NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
79	TITLE : CHEMICAL TESTING AND QC FOR ORGANIC COMPOSITE MATERIALS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. FRIAR COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL	COMPOSITES ORGANIC CHEMICAL TESTING POLYMERS CALORIMETRY CURING MONITORING QUALITY CONTROL
80	TITLE : DESTRUCTIVE TEST OF HARD COATING ADHESION COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	COATINGS PLATING GUN TUBES CHROMIUM ADHESION SHOCK TESTING THERMAL SHOCK DESTRUCTIVE
81	TITLE : NONDESTRUCTIVE CHARACTERIZATION OF COATINGS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	COATINGS PLATING GUN TUBES CHROMIUM ADHESION NDE POROSITY THERMOGRAPHY
82	TITLE : AUTOMATED ANALYSIS AND CONTROL OF METAL FINISHING PROCESS SOLUTIONS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : CHEMICAL	PLATING SOLUTIONS CHEMISTRY MONITORING CONTROL ON-LINE ANALYSIS TITRATION X-RAY FLOURESCENCE
83	TITLE : ULTRASONIC IMMERSION TESTING OF BILLETS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	BILLETS GUN TUBES EVACUATOR NDE VOIDS INCLUSIONS ULTRASONICS NONE
84	TITLE : RESIDUAL STRESS INSPECTION OF GUN TUBES COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT / SOFTWARE	GUN TUBES RESIDUAL STRESS NDE INSPECTION AUTOFRETTAGE X-RAY DIFFRACTION NONE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
85	TITLE : MEASUREMENT AND CONTROL OF CUTTING TOOL DEGENERATION COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : R. WHARTON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT / SOFTWARE	CUTTING TOOL DEGRADATION MACHINING MONITORING NDE INFRARED CONTROL GUN TUBES
86	TITLE : REAL TIME MONITORING AND REGULATION OF ROTARY FORGE PROCESS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : R. WHARTON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	GUN TUBES FORGING MONITORING CONTROL REAL TIME PROCESS CONTROL NONE NONE
87	TITLE : MODAL TESING OF MACHINE TOOLS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : R. WHARTON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	MACHINE TOOL DAMAGE NDE MODAL TESTING VIBRATION CONTROL NONE NONE
88	TITLE : CHARACTERIZATION OF BORE DEFECTS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : R. WHARTON COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT / SOFTWARE	GUN TUBES BORE DEFECTS NDE AUTOMATED CHARACTERIZATION LASER NONE
89	TITLE : RESPONSE OF MATERIALS TO HIGH RATE LOADING COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : G. CAPSIMALIS COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	GUN TUBES CERAMICS COMPOSITES STEEL LOADING HIGH STRESS DYNAMIC TESTING COMPUTERIZED
90	TITLE : LIFE CYCLE TESTING OF WEAPONS COMPONENTS COMMAND : AMCCOM INSTAL'N : WVT PRESENTER : A. BENET LABS COST($K) : 1500 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	BREECHES LARGE CALIBER LIFE-CYCLE LOADING EVALUATION TEST CHAMBER NONE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
91	TITLE : REAL-TIME SENSORS AND METHODOLOGY FOR PROCESS CONTROL	SENSORS PROCESS CONTROL
	COMMAND : LABCOM — INSTAL'N : MTL	METHODS
	PRESENTER : K. RICE — COST($K) : 0	PLATING
	TESTING TECHNOLOGIES :	WELDING
	MECHANICAL — CHEMICAL	SURFACE PROCESSING
	NONDESTRUCTIVE — ELECT / SOFTWARE	NDE ION IMPLANTATION
92	TITLE : CERAMIC ARMOR DEVELOPMENT AND TESTING	CERAMICS PROCESS CONTROL
	COMMAND : LABCOM — INSTAL'N : MTL	NDE
	PRESENTER : K. RICE — COST($K) : 0	ARMOR
	TESTING TECHNOLOGIES :	EVALUATION
	MECHANICAL	NONE
	NONDESTRUCTIVE	NONE NONE
93	TITLE : DEVELOPMENT OF CERAMICS FOR HEAT ENGINES AND GUN TUBES	CERAMICS MATERIALS
	COMMAND : LABCOM — INSTAL'N : MTL	NDE
	PRESENTER : K. RICE — COST($K) : 0	HEAT ENGINES
	TESTING TECHNOLOGIES :	GUN TUBES
	MECHANICAL	BEARINGS
	NONDESTRUCTIVE	NONE NONE
94	TITLE : DEVELOPMENT OF DUAL-HARDNESS STEELS AND CORROSION RESISTANT STEELS	STEEL RESEARCH
	COMMAND : LABCOM — INSTAL'N : MTL	DEVELOPMENT
	PRESENTER : K. RICE — COST($K) : 0	HIGH HARDNESS
	TESTING TECHNOLOGIES :	HIGH TOUGHNESS
	MECHANICAL	DUAL HARDNESS
	NONDESTRUCTIVE	CORROSION RESISTANCE
95	TITLE : DEVELOPMENT OF POWDERED METALS AND RAPID SOLIDIFICATION PROCESSED METALS	METALS POWDERED
	COMMAND : LABCOM — INSTAL'N : MTL	RAPID SOLIDIFICATION
	PRESENTER : K. RICE — COST($K) : 0	ARMOR
	TESTING TECHNOLOGIES :	GUN TUBES
	MECHANICAL	STRUCTURAL
	NONDESTRUCTIVE	GEARS BEARINGS
96	TITLE : DEVELOPMENT OF POLYMER AND COMPOSITE MATERIALS AND TESING TECHNOLOGY	POLYMERS COMPOSITES
	COMMAND : LABCOM — INSTAL'N : MTL	ELASTOMERS
	PRESENTER : K. RICE — COST($K) : 0	ADHESIVES
	TESTING TECHNOLOGIES :	MATERIALS
	MECHANICAL	DEVELOPMENT
	NONDESTRUCTIVE	STRUCTURES NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
97	TITLE : COMPUTER SIMULATION OF FINITE PLASTICITY THEORY COMMAND : LABCOM INSTAL'N : MTL PRESENTER : A. CHOU COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	SIMULATION COMPUTER MODELING ARMOR PENETRATION IMPACT METALS CERAMICS NONE
98	TITLE : DAMAGE MODELING FOR ADVANCED ARMOR AND ANTIARMOR MATERIALS COMMAND : LABCOM INSTAL'N : MTL PRESENTER : A. CHOU COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	SIMULATION COMPUTER MODELING ARMOR PENETRATION FRAGMENTATION DAMAGE METALS CERAMICS
99	TITLE : NEUTRON ANALYSIS OF CERAMIC INJECTION MOLDING PROCESS COMMAND : LABCOM INSTAL'N : MTL PRESENTER : J. ANTAL COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	CERAMICS INJECTION MOLDING CHARACTERIZATION NEUTRON ANALYSIS RADIATION NEUTRON ABSORPTION SHIELDING
100	TITLE : NEUTRON ANALYSIS OF CORROSION PROCESSES IN AIRFOILS COMMAND : LABCOM INSTAL'N : MTL PRESENTER : J. ANTAL COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT / SOFTWARE	CORROSION DETECTION NEUTRON RADIOGRAPHY AIRFOILS AIRCRAFT IMAGING SOFTWARE
101	TITLE : NEUTRON ANALYSIS OF ADHESION BETWEEN INORGANIC MATERIALS COMMAND : LABCOM INSTAL'N : MTL PRESENTER : J. ANTAL COST($K) : 0 TESTING TECHNOLOGIES : NONDESTRUCTIVE	ADHESIVES BONDS INORGANICS NEUTRON RADIOGRAPHY AIRCRAFT STRUCTURES MOISTURE
102	TITLE : MECHANICAL PROPERTIES FATIGUE AND STRESS PREDICTION COMMAND : LABCOM INSTAL'N : MTL PRESENTER : J. NUNES COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	COMPOSITES POLYMERS CERAMICS MECHANICAL FATIGUE STRESS MATERIALS TESTING

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
103	TITLE : MODELING AND SIMULATION OF BALLISTIC BEHAVIOR	BALLISTICS IMPACT
	COMMAND : LABCOM	INSTAL'N : MTL	SIMULATION
	PRESENTER : A. CHOU	COST($K) : 0	MODELING
	TESTING TECHNOLOGIES :		EVENTS
	MECHANICAL		ARMOR
	ELECT / SOFTWARE		MATERIALS
			NONE
104	TITLE : ADVANCED NONDESTRUCTIVE EVALUATION TECHNIQUES	NDE METHODS
	COMMAND : LABCOM	INSTAL'N : MTL	ENHANCEMENTS
	PRESENTER : W. ROY	COST($K) : 0	MATERIALS
	TESTING TECHNOLOGIES :		EMERGING
			COMPOSITES
	NONDESTRUCTIVE ELECT / SOFTWARE	CERAMICS
		NONE
105	TITLE : NDE FOR IN-PROCESS CONTROL AND INSPECTION	NDE PROCESS CONTROL
	COMMAND : LABCOM	INSTAL'N : MTL	MONITORING
	PRESENTER : W. ROY	COST($K) : 0	INSPECTION
	TESTING TECHNOLOGIES :		COMPOSITES
			CERAMICS
	NONDESTRUCTIVE ELECT / SOFTWARE	NONE
		NONE
106	TITLE : NDE OF ADHESIVE BOND INTEGRITY	NDE ADHESIVES
	COMMAND : LABCOM	INSTAL'N : MTL	BONDS
	PRESENTER : W. ROY	COST($K) : 0	INTEGRITY
	TESTING TECHNOLOGIES :		INSPECTION
			COMPOSITES
	NONDESTRUCTIVE	TOMOGRAPHY
		ULTRASONICS
107	TITLE : NDE METHODS FOR CORROSION DETECTION AND ASSESSMENT	CORROSION DETECTION
	COMMAND : LABCOM	INSTAL'N : MTL	AIRCRAFT
	PRESENTER : F. LANDMAN	COST($K) : 0	BLADES
	TESTING TECHNOLOGIES :		AIRFOILS
			NDE
	NONDESTRUCTIVE	INSPECTION
		NONE
108	TITLE : STANDARDIZATION OF COMPOSITE TESTING METHODS AND MATERIALS PROPERTIES DATABASE	COMPOSITES PROPERTIES
	COMMAND : LABCOM	INSTAL'N : MTL	MECHANICAL
	PRESENTER : W. ROY	COST($K) : 0	MATERIALS
	TESTING TECHNOLOGIES :		STANDARDIZATION
	MECHANICAL	DATABASE
		NONE
		NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
109	TITLE : ARTIFICIAL INTELLIGENCE CAMOUFLAGE RESEARCH TEST BED	CAMOUFLAGE DESIGN
	COMMAND : TROSCOM INSTAL'N : NATICK	EVALUATION
	PRESENTER : L. HEPFINGER COST($K) : 300	ARTIFICIAL INTEL
	TESTING TECHNOLOGIES :	CLOTHING PATTERNS
	NONDESTRUCTIVE	NONE NONE
110	TITLE : BALLISTIC DATA FOR CASUALTY REDUCTION AND TRANSIENT DEFROMATION ANALYSIS	ARMOR HELMETS
	COMMAND : TROSCOM INSTAL'N : NATICK	MATERIALS
	PRESENTER : G. OLEJNICZAK COST($K) : 0	BALLISTICS
	TESTING TECHNOLOGIES :	PENETRATION FRAGMENTATION
	NONDESTRUCTIVE	PROTECTION DEFORMATION
111	TITLE : VAPOR ADSORPTION AND PERMEATION ANALYZER	GARMENTS CLOTHING
	COMMAND : TROSCOM INSTAL'N : NATICK	PROTECTION
	PRESENTER : D. RIVIN COST($K) : 100	CHEMICAL AGENTS
	TESTING TECHNOLOGIES :	ADSORPTION
	MECHANICAL CHEMICAL	PERMEATION EVALUATION CHROMATOGRAPHY
112	TITLE : ACCELERATED WEATHERING AT EXTREME TEMPERATURES	WEATHERING TEXTILES
	COMMAND : TROSCOM INSTAL'N : NATICK	ACCELERATED
	PRESENTER : C. HEATH COST($K) : 90	CLOTHING
	TESTING TECHNOLOGIES :	EXPOSURE
	MECHANICAL	TEMPERATURE DAYLIGHT NONE
113	TITLE : ADVANCED DESIGN VISIBLE AND NEAR INFRARED SPECTROMETER	CLOTHING FABRICS
	COMMAND : TROSCOM INSTAL'N : NATICK	SPECTROPHOTOMETER
	PRESENTER : A. COMMERFORD COST($K) : 125	REFLECTANCE
	TESTING TECHNOLOGIES :	VISIBLE INFRARED
	NONDESTRUCTIVE	COUNTERMEASURES FLOURESCENCE
114	TITLE : VIBRATION AND LOW TEMPERATURE AT ALTITUDE TESTING	VIBRATION LOW TEMPERATURE
	COMMAND : TROSCOM INSTAL'N : NATICK	SURVIVAL KIT
	PRESENTER : D. QUERIM COST($K) : 50	SLEEPING BAG
	TESTING TECHNOLOGIES :	AIRCRAFT
	MECHANICAL	ALTITUDE TESTING PACKAGING VACUUM

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
115	TITLE : FULL ENSEMBLE TESTING COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : R. KINNEY COST($K) : 500 TESTING TECHNOLOGIES : MECHANICAL CHEMICAL	CLOTHING NBC EVALUATION ENSEMBLE SAMPLING SIMULANTS CHALLENGE PROTECTION
116	TITLE : VAPOR CONTAMINATION VAPOR PENETRATION SWATCH TEST COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : R. KINNEY COST($K) : 100 TESTING TECHNOLOGIES : MECHANICAL	CLOTHING CONTAMINATION PENETRATION VAPOR PROTECTION EVALUATION NBC DIFFUSION
117	TITLE : LABORATORY TEST FOR FIELD WEAR AND DURABILITY COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : C. FITZGERALD COST($K) : 500 TESTING TECHNOLOGIES : MECHANICAL	CLOTHING WEAR DURABILITY FIELD TESTING EQUIVALENCY MODELING NONE NONE
118	TITLE : TESTING FOR MULTIPLE THREAT INDIVIDUAL PROTECTIVE SYSTEMS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : C. FITZGERALD COST($K) : 150 TESTING TECHNOLOGIES : MECHANICAL CHEMICAL	CLOTHING PROTECTIVE MULTIPLE THREAT NBC SYSTEM EVALUATION ENSEMBLE CVC
119	TITLE : IMPACT ENERGY ABSORPTION TEST METHOD COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : S. WACLAWIK COST($K) : 50 TESTING TECHNOLOGIES : MECHANICAL	IMPACT ABSORPTION HELMETS BODY ARMOR POLYMERS PROTECTION STANDARDIZATION EVALUATION
120	TITLE : LIFE AND PERFORMANCE TESTING OF NOVEL HEAT ENGINES AND SMALL COMPRESSORS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : M. KUPCINSKAS COST($K) : 10 TESTING TECHNOLOGIES : MECHANICAL	IMCS HEAT ENGINES COMPRESSOR COOLING WEAR EVALUATION NBC CLOTHING

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
121	TITLE : PUNCTURE RESISTANCE OF NON-COATED CLOTHS	CLOTHING PUNCTURE
	COMMAND : TROSCOM INSTAL'N : NATICK	RESISTANCE
	PRESENTER : D. QUERIM COST($K) : 165	PARACHUTE
	TESTING TECHNOLOGIES :	ROUGH TERRAIN
	MECHANICAL	SUIT
		EVALUATION
		NONE
122	TITLE : RF PORTABLE REFLECTOMETER	CLOTHING REFLECTANCE
	COMMAND : TROSCOM INSTAL'N : NATICK	ABSORPTION
	PRESENTER : D. RAPACZ COST($K) : 75	RADAR
	TESTING TECHNOLOGIES :	DETECTION
		EVALUATION
	NONDESTRUCTIVE	PROTECTION
		NONE
123	TITLE : DETERIORATION OF BIODEGRADABLE CONTAINER	PACKAGING DEGRADATION
	COMMAND : TROSCOM INSTAL'N : NATICK	RATIONS
	PRESENTER : D. GORDON COST($K) : 100	CONTAINER
	TESTING TECHNOLOGIES :	BIODEGRADATION
	MECHANICAL CHEMICAL	INERTNESS
	ELECT / SOFTWARE	NONE
		NONE
124	TITLE : STORAGE STABILITY MEASUREMENT	RATIONS STORAGE
	COMMAND : TROSCOM INSTAL'N : NATICK	STABILITY
	PRESENTER : D. GORDON COST($K) : 200	SHELF LIFE
	TESTING TECHNOLOGIES :	EVALUATION
	MECHANICAL CHEMICAL	AMBIENT
	ELECT / SOFTWARE	CHILLED
		NONE
125	TITLE : AIR QUALITY MONITOR	AIR QUALITY
	COMMAND : TROSCOM INSTAL'N : NATICK	MONITORING
	PRESENTER : R. LAMPI COST($K) : 125	FIELD
	TESTING TECHNOLOGIES :	SHELTERS
	CHEMICAL	TRAILERS
		FEEDING
		COMBUSTION PRODUCTS
126	TITLE : SUPRS CHAMBER STRESS INDICATOR	SUPRS UNDERWATER
	COMMAND : TROSCOM INSTAL'N : NATICK	SUPPLY
	PRESENTER : R. LAMPI COST($K) : 250	SUBSISTANCE
	TESTING TECHNOLOGIES :	CHAMBER
	MECHANICAL	CONDITION
	NONDESTRUCTIVE	DETECTION
		NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
127	TITLE : AUTOMATED NONDESTRUCTIVE ON-LINE DETECTION OF DEFECTS IN FOOD RETORT POUCHES COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : R. MANSUR COST($K) : 200 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	MEAL POUCH NDE INSPECTION AUTOMATED PERFORATION SPECTROMETER SEAL
128	TITLE : NONDESTRUCTIVE VACUUM TESTING OF TRAY PACKS IN FIELD AND DEPOT COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : P. BURKE COST($K) : 155 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	TRAY PACKS VACUUM NDE INSPECTION FIELD CANS SEAL MEAL
129	TITLE : NON-COMPLEX ITEMS AND MATERIALS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : J. HALL COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	STRAPS PARACHUTE TENTAGE MATERIALS FATIGUE DYNAMIC HIGH STRAIN TESTING
130	TITLE : HIGH SPEED AIRDROP CONTAINER (HISAC) MATERIALS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : A. MAWN COST($K) : 46 TESTING TECHNOLOGIES : MECHANICAL CHEMICAL	HISAC CONTAINER AIR DROP MATERIALS DEVELOPMENT TESTING NONE NONE
131	TITLE : DETECTION OF THERMAL AGING IN NYLON 6,6 COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : M. GIONFRIDDO COST($K) : 190 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	WEBBING CORDAGE STRAPPING AGING NYLON NDE INSPECTION OPTICAL ABSORPTION
132	TITLE : MONITORING ULTRAVIOLET (UV) DEGRADATION IN NYLON 6,6 COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : M. GIONFRIDDO COST($K) : 250 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	NYLON DEGRADATION ULTRAVIOLET PARACHUTE TEXTILES NDE INSPECTION NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
133	TITLE : HAND HELD PORTABLE EMI LEAK DETECTOR COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : A. MURPHY COST($K) : 0 TESTING TECHNOLOGIES : ELECT / SOFTWARE	ELECTROMAGNETICS LEAKAGE DETECTION PORTABLE SHELTERS EMI RADIATION NONE
134	TITLE : NONDESTRUCTIVE EVALUATION FOR SANDWICH COMPOSITE MATERIALS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : S. STROBEL COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL NONDESTRUCTIVE	COMPOSITES NDE DEFECTS PORTABLE ULTRASONICS INFRARED SHELTERS CONSTRUCTION MATERIA
135	TITLE : AEROSOL PENETRABILITY OF MATERIALS AND CLOSURES COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : J. MAYER COST($K) : 200 TESTING TECHNOLOGIES : CHEMICAL	CLOTHING NBC PENETRATION AEROSOL PROTECTION PARTICULATE NONE NONE
136	TITLE : MANPRINT TESTING FOR NATICK MATERIALS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : L. SYMINGTON COST($K) : 700 TESTING TECHNOLOGIES : MECHANICAL ANTHROPLOGIC	MANPRINT CONFORMANCE TESTING CLOTHING SHELTERS EQUIPMENT BEHAVIORAL ANTHROPOLOGICAL MATERIALS
137	TITLE : LABORATORY AND FIELD TESTING OF RATIONS COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : E. HIRSCH COST($K) : 600 TESTING TECHNOLOGIES : CHEMICAL	RATIONS CONSUMPTION ACCEPTABILITY SENSORY CHARACTERIST FIELD USE NUTRITION NONE NONE
138	TITLE : IMPROVED TEST METHODOLOGIES FOR CHEMICAL DEFENSE COMMAND : TROSCOM INSTAL'N : NATICK PRESENTER : J. CARLSON COST($K) : 1600 TESTING TECHNOLOGIES : CHEMICAL	DECONTAMINATION CLOTHING DETOXIFICATION BY-PRODUCTS DEFENSE CHEMICAL EXPOSURE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
139	TITLE : AUTOMATED INSPECTION SYSTEM TO ELIMINATE VISUAL CRITICAL INSPECTION	FUZES INSPECTION
	COMMAND : AMCCOM — INSTAL'N : PICATINNY	AUTOMATED
	PRESENTER : A. THIESING — COST($K) : 400	VISUAL
	TESTING TECHNOLOGIES :	PLUNGER DETONATOR
	NONDESTRUCTIVE	VISION SYSTEM COMPUTERIZED
140	TITLE : AGT 1500 ENGINE MODULE TEST	ENGINE MODULE TESTING
	COMMAND : DESCOM — INSTAL'N : ANNISTON	RECUPERATORS
	PRESENTER : W. BONDARCHUK — COST($K) : 0	COMPRESSOR
	TESTING TECHNOLOGIES :	TURBINE
	MECHANICAL	TANK
	ELECT / SOFTWARE	TEST STAND
	ENGINEERING	NONE
141	TITLE : TEST RUBBER COMPOUNDS	ROADWHEELS TRACK PADS
	COMMAND : TACOM — INSTAL'N : WARREN	RUBBER COMPOUNDS
	PRESENTER : W. KLECKER — COST($K) : 0	ELASTOMERS
	TESTING TECHNOLOGIES :	DURABILITY
	MECHANICAL	TANK
	NONDESTRUCTIVE	M1A1 NONE
142	TITLE : COMPUTED TOMOGRAPHY NDI FOR RECUPERATORS	RECUPERATORS ENGINES
	COMMAND : TACOM — INSTAL'N : WARREN	TANK
	PRESENTER : J. HERBERT — COST($K) : 1000	NDE
	TESTING TECHNOLOGIES :	TOMOGRAPHY WELDS
	NONDESTRUCTIVE	INSPECTION DAMAGE
143	TITLE : AUTOMATED ROADWHEEL INSPECTIONS	ROADWHEELS BONDS
	COMMAND : TACOM — INSTAL'N : WARREN	ELASTOMERS
	PRESENTER : T. MIESZCZAK — COST($K) : 500	NDE
	TESTING TECHNOLOGIES :	AUTOMATED ADHESIVES
	NONDESTRUCTIVE	ACOUSTO-ULTRASONICS INSPECTION
144	TITLE : FATIGUE GAGES	FATIGUE METALS
	COMMAND : TECOM — INSTAL'N : WARREN	NON-METALLICS
	PRESENTER : H. HOBOLTH — COST($K) : 0	GAGING
	TESTING TECHNOLOGIES :	LIFE
	MECHANICAL CHEMICAL	MONITORING NONE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
145	TITLE : COMPONENT CORROSION TEST	CORROSION COMPONENTS
	COMMAND : TECOM — INSTAL'N : WARREN	FAILURE
	PRESENTER : H. HOBOLTH — COST($K) : 0	ENVIRONMENTAL
	TESTING TECHNOLOGIES :	CHAMBER
	MECHANICAL — CHEMICAL	TESTING NONE
	ENVIRONMENT	NONE
146	TITLE : THREADED FASTENER PLATING INVESTIGATION	PLATING MATERIALS
	COMMAND : TACOM — INSTAL'N : WARREN	ALTERNATIVES
	PRESENTER : J. POLKOWSKI — COST($K) : 120	CADMIUM
	TESTING TECHNOLOGIES :	FASTENERS
	MECHANICAL — CHEMICAL	MECHANICAL CHEMICAL TESTING PROPERTIES
147	TITLE : ELECTROMIGRATION DEGRADATION MECHANISMS OF MICROCIRCUIT DEVICES	MICROELECTRONICS FAILURE
	COMMAND : MICOM — INSTAL'N : REDSTONE	ELECTROMIGRATION
	PRESENTER : N. DONLIN — COST($K) : 215	DEGRADATION
	TESTING TECHNOLOGIES :	RELIABILITY ELECTRONICS
	NONDESTRUCTIVE — ELECT / SOFTWARE	DEVICES MATERIALS
148	TITLE : IMPLEMENTATION OF MAGNETO-OPTICAL MAPPER (MOM)	MICROELECTRONICS DETECTOR
	COMMAND : MICOM — INSTAL'N : REDSTONE	SEMICONDUCTOR
	PRESENTER : G. TANTON — COST($K) : 400	ARRAYS
	TESTING TECHNOLOGIES :	MAPPER MAGNETO-OPTICAL
	NONDESTRUCTIVE — ELECT / SOFTWARE	STINGER DEFECTS
149	TITLE : ADVANCED SOFTWARE VERIFICATION TOOL	SOFTWARE VERIFICATION
	COMMAND : CECOM — INSTAL'N : MONMOUTH	DESIGN
	PRESENTER : P. KOGUT — COST($K) : 300	ARTIFICIAL INTEL
	TESTING TECHNOLOGIES :	REQUIREMENTS ENGINEERING
	ELECT / SOFTWARE	CASE CCCI
150	TITLE : IMPLEMENTATION OF SOFTWARE RELIABILITY PROGRAM	SOFTWARE RELIABILITY
	COMMAND : CECOM — INSTAL'N : MONMOUTH	EVALUATION
	PRESENTER : P. KOGUT — COST($K) : 400	FAILURE
	TESTING TECHNOLOGIES :	ESTIMATION OPERATION
	ELECT / SOFTWARE	NONE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
151	TITLE : SOFTWARE PROCESS IMPROVEMENT THROUGH ERROR DETECTION AN PREVENTION COMMAND : CECOM INSTAL'N : MONMOUTH PRESENTER : P. KOGUT COST($K) : 600 TESTING TECHNOLOGIES : ELECT / SOFTWARE	SOFTWARE ERROR DETECTION MAINTENANCE CCCI QUALITY ASSURANCE NONE NONE
152	TITLE : MICROWAVE/MILLIMETER WAVE INTEGRATED CIRCUIT ENVIRONMENTAL STRESS AND LIFE TEST COMMAND : LABCOM INSTAL'N : ETDL PRESENTER : P. RESTINE COST($K) : 2000 TESTING TECHNOLOGIES : MECHANICAL ELECT / SOFTWARE	MICROELECTRONICS MICROWAVE MILLIMETER WAVE RELIABILITY RF SWITCHING ENVIRONMENTAL STRESS LIFE
153	TITLE : HIGH SPEED (200MHZ) - HIGH PIN COUNT (512 PINS) ATE COMMAND : LABCOM INSTAL'N : ETDL PRESENTER : J. ERICKSON COST($K) : 400 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT / SOFTWARE	MICROELECTRONICS DEVICE ATE AUTOMATED TESTING HIGH SPEED HIGH PIN COUNT MICROCIRCUITS
154	TITLE : LASER NONDESTRUCTIVE PROBING FOR MICROWAVE DEVICES (1GHZ AND ABOVE) COMMAND : LABCOM INSTAL'N : ETDL PRESENTER : R. SARTORE COST($K) : 500 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT / SOFTWARE	MICROELECTRONICS DEVICE MICROWAVE MILLIMETER WAVE LASER NDE PROCESS CONTROL QUALITY CONTROL
155	TITLE : LOCAL AREA NETWORK TEST FACILITY COMMAND : CECOM INSTAL'N : MONMOUTH PRESENTER : H. WICHANSKY COST($K) : 0 TESTING TECHNOLOGIES : ELECT / SOFTWARE	NETWORK LAN PERFORMANCE INTEROPERABILITY PROTOCOLS CCCI ENGINEERING TESTING
156	TITLE : NEUTRAL TEST BED FOR MORTAR AMMUNITION TESTING COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : M. SPIELZINGER COST($K) : 100 TESTING TECHNOLOGIES : MECHANICAL	MORTARS AMMUNITION TESTING MOUNTS RECOIL STANDARDIZATION NONE NONE

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
157	TITLE : MECHANICAL TESING OF COMPOSITES COMMAND : ARDEC INSTAL'N : PICATINNY PRESENTER : C. SALLADE COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	COMPOSITES MECHANICAL PROPERTIES PROCEDURES STANDARDIZATION MATERIALS AMMUNITION NONE
158	TITLE : STATIC TESTING FOR SPIN AND SET BACK COMMAND : ARDEC INSTAL'N : PICATINNY PRESENTER : L. LECONEY COST($K) : 0 TESTING TECHNOLOGIES : MECHANICAL	AMMUNITION SPIN SET BACK STATIC SIMULATION FORCES ARTILLERY NONE
159	TITLE : RAPIDLY ANALYZING SINGLE BASE PROPELLANTS BY NIRR FOR PROCESS CONTROL COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : H. CHU COST($K) : 400 TESTING TECHNOLOGIES : CHEMICAL NONDESTRUCTIVE	PROPELLANTS COMPOSITION CHEMICAL ANALYSIS INFRARED PROCESS CONTROL M-6 NONE
160	TITLE : STORAGE STABILITY TESTING O PYROTECHNICS AND EXPLOSIVE MATERIALS COMMAND : ARDEC INSTAL'N : PICATINNY PRESENTER : F. TAYLOR COST($K) : 150 TESTING TECHNOLOGIES : CHEMICAL	EXPLOSIVES PYROTECHNICS STABILITY STORAGE COMPATIBILITY LONG TERM CALORIMETRY PROPELLANTS
161	TITLE : NDE OF COMPOSITE MATERIALS COMMAND : ARDEC INSTAL'N : PICATINNY PRESENTER : C. SALLADE COST($K) : 150 TESTING TECHNOLOGIES : NONDESTRUCTIVE	COMPOSITES NDE MATERIALS AMMUNITION ACCEPTANCE ULTRASONICS STANDARDS NONE
162	TITLE : RECOVERY OF ARCHIVED DIGITIZED INSPECTION DATA COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : P. WILLSON COST($K) : 50 TESTING TECHNOLOGIES : NONDESTRUCTIVE ELECT SOFTWARE	INSPECTION DATA DIGITIZED ARCHIVED NDE RADIOGRAPH IMAGES STANDARDIZATION

SUMMARY LISTING OF INDIVIDUAL SURVEY SUBMISSIONS (CONT'D)

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
163	TITLE : CARTRIDGE CASE GLUE JOINT TESTING COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : R. SCHUBERT COST($K) : 150 TESTING TECHNOLOGIES : NONDESTRUCTIVE	CARTRIDGE JOINTS ADHESIVES NDE AMMUNITION ULTRASONICS TANK NONE
164	TITLE : BURNING RESIDUE INSTRUMENTATION COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : R. SCHUBERT COST($K) : 200 TESTING TECHNOLOGIES : NONDESTRUCTIVE OPTICAL	PROPELLANTS RESIDUE BURNING INSPECTION INFRARED AMMUNITION TANK NONE
165	TITLE : APPLICATION OF NDE METHODS TO GRAPHITE REINFORCED PLASTICS (GRP) COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : G. PACELLA COST($K) : 150 TESTING TECHNOLOGIES : NONDESTRUCTIVE	PLASTICS GRAPHITE REINFORCED GRP NDE COMPOSITES CURE PROCESS CONTROL NONE
166	TITLE : PRINTED CIRCUIT BOARD LAMINOGRAPHIC X-RAY INSPECTION COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : E. BARNES COST($K) : 1200 TESTING TECHNOLOGIES : NONDESTRUCTIVE	CIRCUIT BOARDS MULTI LAYERED INSPECTION X-RAY SOLDER JOINTS LAMINOGRAPHY SADARM STAFF
167	TITLE : BACKSCATTER TOMOGRAPHY OF COMPOSITE STRUCTURES COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : E. BARNES COST($K) : 1500 TESTING TECHNOLOGIES : NONDESTRUCTIVE	COMPOSITES INSPECTION HOWITZER TOMOGRAPHY BACKSCATTER X-RAY ONE SIDED NDE
168	TITLE : TESTING OF RESTRICTED STOCKPILED MUNITIONS COMMAND : AMCCOM INSTAL'N : PICATINNY PRESENTER : E. BARNES COST($K) : 1500 TESTING TECHNOLOGIES : NONDESTRUCTIVE	MUNITIONS TESTING NDE STORAGE STOCKPILE INSPECTION X-RAY REAL TIME

TNS#	TESTING NEEDS SURVEY INFORMATION	KEYWORDS
169	TITLE : HYDROGEN EMBRITTLEMENT TESTING	GRENADES NDE
	COMMAND : AMCCOM — INSTAL'N : PICATINNY	HYDROGEN EMBRITTLE
	PRESENTER : E. BARNES — COST($K) : 1500	NEUTRON
	TESTING TECHNOLOGIES :	SCATTERING M42
	NONDESTRUCTIVE	MUNITIONS NONE
170	TITLE : VISUAL INSPECTION BY NEURAL NETWORK TECHNIQUES	INSPECTION VISUAL
	COMMAND : AMCCOM — INSTAL'N : PICATINNY	NEURAL NETWORK
	PRESENTER : E. BARNES — COST($K) : 2000	AUTOMATED
	TESTING TECHNOLOGIES :	ARTIFICIAL INTEL MUNITIONS
	NONDESTRUCTIVE — ELECT / SOFTWARE	LEARNING NONE
171	TITLE : SMART MUNITION AUTOMATIC INSPECTION BY RADIOGRAPHY	MUNITIONS INSPECTION
	COMMAND : AMCCOM — INSTAL'N : PICATINNY	AUTOMATED
	PRESENTER : E. BARNES — COST($K) : 1000	RADIOGRAPHY
	TESTING TECHNOLOGIES :	X-RAY REAL TIME
	NONDESTRUCTIVE	SADARM NONE
172	TITLE : IMPLEMENTATION OF REVISED MIL-STD 286B METHOD 901 CLOSED BOMB TESTING AT RADFORD	PROPELLANTS BURN TESTING
	COMMAND : AMCCOM — INSTAL'N : PICATINNY	CLOSED BOMB
	PRESENTER : J. DOMEN — COST($K) : 42	BURN RATE
	TESTING TECHNOLOGIES :	QUICKNESS
	CHEMICAL	VERIFICATION
	ELECT / SOFTWARE	SOFTWARE NONE
173	TITLE : WIDE AREA MINE (WAM)	MINES WIDE AREA
	COMMAND : ARDEC — INSTAL'N : PICATINNY	ANTI TANK
	PRESENTER : W. SMITH — COST($K) : 0	TESTING
	TESTING TECHNOLOGIES :	SIMULATOR WAM
	ELECT / SOFTWARE	NONE NONE
174	TITLE : NEW ACCEPTANCE TESTS FOR THE COLOR QUALITY OF PYROTECHNIC SIGNALS	PYROTECHNICS SIGNALS
	COMMAND : ARDEC — INSTAL'N : PICATINNY	COLOR QUALITY
	PRESENTER : G. VENABLE — COST($K) : 210	ACCEPTANCE
	TESTING TECHNOLOGIES :	TESTING PHOTOMETRY
	ELECT / SOFTWARE	SPECTRAL DATA NONE

APPENDIX C.3

SAMPLE OF SURVEY INFORMATION SUMMARY FORM

SAMPLE OF SURVEY INFORMATION SUMMARY FORM

FY1988 AMC MTT PROGRAM TESTING NEEDS SURVEY
INFORMATION SUMMARY FORM

INSTALLATION: Watervliet Arsenal, Benet Labs DATE: September 1988
PRESENTER: G.P. Capsimalis/M. Doxbeck ORGANIZATION: Phys. Sci. Branch
AUTOVON/PHONE: 974-5615

TESTING NEED TITLE: Residual Stress Inspection of Gun Tubes

END ITEM SUPPORTED: 105-mm, 120-mm, 155-mm, 8-inch diameter Gun Tubes.
DESC/PURPOSE:

WHEN IS TESTING NEED REQUIRED?: Now
SOLUTION TO NEED EXISTS TODAY?: YES X NO
SOLUTION REQUIRES R&D?: YES NO X
ESTIMATED COST OF SOLUTION: $160K
TESTING TECHNOLOGY REQ'D: MECH CHEM NDT X ELECT/SFTWR X
OTHER (DESC.)

TESTING NEED DESCRIPTION/PURPOSE:

Autofrettaging significantly extends the service life of gun tubes. To develop this process to its full potential, the Watervliet Arsenal requires a method to measure the resulting residual stresses. At present, the only techniques utilized are destructive, thereby wasting both time and money.

POSSIBLE SOLUTION:

We can solve this problem by using x-ray diffraction to measure residual stress. With advances made in miniature x-ray tubes and position sensitive detectors, we are now able to measure residual stress non-destructively inside a gun tube. This unit will be able to measure both hoop and longitudinal residual stress at the bore.

POTENTIAL BENEFITS: With such a system, the Watervliet Arsenal could:

a) detect nonuniform and/or unsafe stress levels
b) detect variations in stress levels caused by changes in the manufacturing process or materials.
c) observe residual stress levels after straightening.
d) obtain data to improve the autofrettage process.
e) obtain data for sue in designing lightweight cannons.

THIS SHOT IS
KEYWORDS: GUN TUBES; RESIDUAL STRESS, NDE INSPECTION, AUTOFRETTAGE, X-RAY DIFFRACTION

SAMPLE OF SURVEY INFORMATION SUMMARY FORM (CONT'D)

FY1988 AMC MTT PROGRAM TESTING NEEDS SURVEY
INFORMATION SUMMARY FORM

INSTALLATION: ET&DL, Fort Monmouth, NJ
PRESENTER: Richard Sartore
AUTOVON/PHONE: 995-2261/(201) 544-2661

DATE: 25 August 1988
ORGANIZATION: LABCOM - ET&DL

TESTING NEED TITLE: Laser Non-Destructive Probing System for Microwave Devices (1GHz and above)

END ITEM SUPPORTED: MIMIC devices. Microwave devices
DESC/PURPOSE: Required for design verification, failure diagnostics and quality/process control.

WHEN IS TESTING NEED REQUIRED?: 4th quarter 1989
SOLUTION TO NEED EXISTS TODAY?: YES X NO ____
SOLUTION REQUIRES R&D?: YES ____ NO X
ESTIMATED COST OF SOLUTION: $500K
TESTING TECHNOLOGY REQ'D: MECH ____ CHEM ____ NDT X ELECT/SFTWR X
OTHER (DESC.) ____

TESTING NEED DESCRIPTION/PURPOSE: DoD/Army are funding multi-million dollar MIMIC program to develop and fabricate MIMIC devices. These devices will require new testing technologies for design verification, failure diagnostics and process/quality control. The testing capability will directly impact reliability and cost effectiveness of MIMIC devices in Army and DoD equipments.

POSSIBLE SOLUTION: The proposed solution for MIMIC testing needs is a non-invasive laser probing system which will measure timing and signal amplitude on MIMIC devices above 1GHZ. Several of these systems have been demonstrated in laboratories and should become commercially available in the near future.

POTENTIAL BENEFITS: The benefit to the MIMIC program will be improved reliabilty by fielding only fully tested and verified MIMIC devices. Further, the utilization of laser non-invasive probing to process/quality control will insure continued reliability/quality in the field.

SAMPLE OF SURVEY INFORMATION SUMMARY FORM (CONT'D)

FY1988 AMC MTT PROGRAM TESTING NEEDS SURVEY
INFORMATION SUMMARY FORM

INSTALLATION: U.S. Army Natick RD&E Center **DATE:** 15 Sep 88
PRESENTER: Carol J. Fitzgerald **ORGANIZATION:** LSSD/IPD
AUTOVON/PHONE: AV 256-5436

TESTING NEED TITLE: Laboratory test for Field Wear and Durability

END ITEM SUPPORTED: All clothing items
DESC/PURPOSE: To determine the durability of a clothing item in the laboratory (i.e., simulate field wear conditions).

WHEN IS TESTING NEED REQUIRED?: ASAP
SOLUTION TO NEED EXISTS TODAY?: YES ____ NO X
SOLUTION REQUIRES R&D?: YES X NO ____
ESTIMATED COST OF SOLUTION: $500K (+)
TESTING TECHNOLOGY REQ'D: MECH X CHEM ____ NDT ____ ELECT/SFTWR ____
OTHER (DESC.) ____

TESTING NEED DESCRIPTION/PURPOSE: Currently materials are subjected to a number of lab tests to determine their physical characteristics prior to field testing. However, these tests cannot be used to generate decision-making data on field wear and durability of clothing items. All items must be subjected to operational testing in a field environment. Development of a test, or more likely a series of tests, which could predict with a reasonable degree of accuracy the durability of clothing items is needed.

POSSIBLE SOLUTION: Development of a battery of tests which can predict field wear, modelled with terrain and environmental conditions could be used very advantageously. Correlation of results with on-going wear tests could allow for determination of the accuracy of the testing/modelling during the development of the methodology.

POTENTIAL BENEFITS: The time and cost savings of running a wear test in the lab would be significant. Although this would likely not eliminate completely the need for actual wear testing in the field, it may allow for verification only in the field, requiring far fewer troops, data collectors and test items. In addition, the time to complete the testing, data collection and analysis, and decision-making processes could be greatly reduced, allowing state-of-the-art items to be fielded more quickly.

TNS NAT 9
KEYWORDS: CLOTHING, WEAR, DURABILITY, FIELD TESTING, EQUIVALENCY, MODELING

FY1988 AMC MTT PROGRAM TESTING NEEDS SURVEY
INFORMATION SUMMARY FORM

INSTALLATION: CCAD (DESCOM) DATE: 5/12/88
PRESENTER: George Wilson ORGANIZATION: _____
AUTOVON/PHONE: _____

TESTING NEED TITLE: Monitoring of Cadmium and other plating processes.

END ITEM SUPPORTED: Aircraft, Engine components, Airframe components
DESC/PURPOSE: _____

WHEN IS TESTING NEED REQUIRED?: Now
SOLUTION TO NEED EXISTS TODAY?: YES ____ NO X
SOLUTION REQUIRES R&D?: YES X NO ____
ESTIMATED COST OF SOLUTION: _____
TESTING TECHNOLOGY REQ'D: MECH ____ CHEM X NDT X ELECT/SFTWR ____
OTHER (DESC.) _____

TESTING NEED DESCRIPTION/PURPOSE: Metal plating processes are very common throughout the Army manufacturing and maintenance sites. Plating of metal parts enhances their resistance to corrosion, chemical attack and wear. Plating processes today remain to be uncontrolled processes which are tested by post-plating batch sampling. A testing method is needed to monitor and ultimately control the plating process, including plating solution monitoring, trace metal detection, and on-line plate thickness measurement.

POSSIBLE SOLUTION: Monitoring of chemical solutions can indicate the progress of chemical plating processes. Other methods may also be available to time and actively control plating processes. Nondestructive methods may also be applicable to the plating processes by providing information on the thickness and the adhesion of the plating on the base metal. Together these techniques can form a complete control methododlgy to plating processes (i.e. cadmuim, chromium, etc.).

POTENTIAL BENEFITS: _____

Keywords: Plating, Process Control, Chemical monitoring, NDE, Aircraft, Cadmium, Chromium PLATING SOLUTIONS

SAMPLE OF SURVEY INFORMATION SUMMARY FORM (CONT'D)

FY1988 AMC MTT PROGRAM TESTING NEEDS SURVEY
INFORMATION SUMMARY FORM

INSTALLATION: Aberdeen Prov. Grnd. (TECOM) DATE: 2/3/88
PRESENTER: Jim Piro ORGANIZATION: _____
AUTOVON/PHONE: _____

TESTING NEED TITLE: Effects of Chemical Agents on Materials, Coatings, and Adhesives.
END ITEM SUPPORTED: Vehicles, Tracked Combat; Optics; Composites, Shelters
DESC/PURPOSE: _____

WHEN IS TESTING NEED REQUIRED?: Now
SOLUTION TO NEED EXISTS TODAY?: YES ____ NO X
SOLUTION REQUIRES R&D?: YES X NO ____
ESTIMATED COST OF SOLUTION: _____
TESTING TECHNOLOGY REQ'D: MECH X CHEM X NDT _ _ ELECT/SFTWR ____
OTHER (DESC.) _____

TESTING NEED DESCRIPTION/PURPOSE: The use of chemical agents in the modern battlefield results in the contamination of all exposes surfaces. A need exists to determine the effects of these agents on the sensitive materials used on vehicles, weapons systems, shelters, and other structures. The of composite materials and adhesive joints in those structures in particular may be adversely affected by contact exposure to chemical agenst. Decontamination fluids are also very corrosive and may affect the mechanical integrity of systems using composites and adhesive joints.

POSSIBLE SOLUTION: Laboratory tests can be conducted to expose various composite materials to chemical agents or simulants. This testing should also include adhesively bonded joints. Decontamination materials may also be tested against sensitive materials and a series of mechnical tests and chemical tests can be conducted to determine the agents effect on the properties of the materials.

POTENTIAL BENEFITS: _____

TNS TEC 5

Keywords: Chemical Agents, Contamination, Decontamination, Susceptibility, Composites, Adhesive Bonds, Optical Coatings, Materials.

APPENDIX C.4

SUBMISSIONS INDEX BY COMMAND AND INSTALLATION

SUBMISSIONS INDEX BY COMMAND AND INSTALLATION

COMMAND	INSTAL'N	TNS DATABASE FORM NUMBERS							
AMCCOM	PICATINNY	139	156	159	162	163	164	165	166
		167	168	169	170	171	172		
AMCCOM	WVT	69	70	71	72	73	74	75	76
		77	78	79	80	81	82	83	84
		85	86	87	88	89	90		
ARDEC	PICATINNY	157	158	160	161	173	174		
CECOM	MONMOUTH	149	150	151	155				
CRDEC	EDGEWOOD	46	47	48	49	50	51	52	53
		54							
DESCOM	ANNISTON	140							
DESCOM	CCAD	1	2	3	4	5	6	7	8
		9	10	11	12	13	14		
DESCOM	LTRK	55	56	57	58	59	60	61	62
		63	64	65	66	67	68		
DESCOM	RRAD	15	16	17	18	19	20	21	22
		23	24						
LADCOM	ETDL	152	153	154					
LABCOM	HDL	25	26	27	28	29	30	31	32
		33	34	35	36				
LABCOM	MTL	91	92	93	94	95	96	97	98
		99	100	101	102	103	104	105	106
		107	108						
MICOM	REDSTONE	147	148						
TACOM	WARREN	141	142	143	146				
TECOM	APG	37	38	39	40	41	42	43	44
		45							
TECOM	WARREN	144	145						
TROSCOM	NATICK	109	110	111	112	113	114	115	116
		117	118	119	120	121	122	123	124
		125	126	127	128	129	130	131	132
		133	134	135	136	137	138		

APPENDIX C.5

SUBMISSIONS INDEX BY PRODUCT CATEGORY

SUBMISSIONS INDEX BY PRODUCT CATEGORY

AMMUNITION AND WEAPONS (69 Entries)

11	17	18	21	24	25	26	28	29	30
31	36	39	42	51	54	56	58	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	93	94	95	98	99	103	104	105	139
156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	

VEHICLES, TRACKED COMBAT AND TACTICAL SUPPORT (47 ENTRIES)

4	6	12	13	14	15	17	19	22	23
24	37	40	45	59	61	64	65	66	67
68	78	91	92	93	94	95	96	97	98
99	100	102	103	104	105	106	107	108	140
141	142	143	144	145	146	169			

AIRCRAFT (33 Entries)

1	2	3	4	5	6	7	8	9	11
12	13	14	20	21	22	64	66	67	68
78	91	100	101	102	104	105	106	107	108
146	167	169							

MISSILES (9 Entries)

11	16	20	27	28	36	39	60	104

PERSONNEL AND SUPPORT EQUIPMENT (56 Entries)

10	11	41	43	44	46	47	48	49	50
51	52	53	54	55	58	61	63	64	65
66	67	69	70	91	96	109	110	111	112
113	114	115	116	117	118	119	120	121	122
123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138				

ELECTRONIC EQUIPMENT AND SOFTWARE (22 Entries)

27	28	32	33	34	35	36	38	39	57
60	62	147	148	149	150	151	152	153	154
155	166								

APPENDIX C.6

SUBMISSIONS INDEX BY PROBLEM AREA

SUBMISSIONS INDEX BY PROBLEM AREAS

MATERIALS CHARACTERIZATION AND PROPERTIES (82 Entries)

1	2	3	4	6	9	10	13	19	21
22	37	38	40	41	42	44	45	47	48
49	50	51	52	54	65	66	67	68	74
76	77	78	79	80	81	82	83	84	85
89	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	119	129	130	131	132	134	136
141	143	144	145	146	147	148	157	161	165
167	169								

AUTOMATED TESTING AND IN-PROCESS CONTROL (58 ENTRIES)

4	14	15	16	17	18	23	34	36	53
55	56	57	59	60	61	66	72	74	75
77	82	85	86	87	88	89	91	92	99
100	105	106	107	109	113	115	116	117	118
122	125	127	139	140	142	143	148	153	154
159	162	164	165	166	168	170	171		

DIAGNOSTIC TESTING AND ASSESSMENT (77 Entries)

1	2	3	5	6	7	8	9	12	13
16	19	20	22	24	32	34	37	41	44
55	56	57	59	60	61	63	64	66	67
68	71	72	75	76	78	79	81	82	83
84	88	93	96	99	100	101	102	104	105
106	107	120	126	127	128	132	134	140	142
143	144	147	148	153	158	160	161	162	163
165	166	167	168	169	171	173			

BONDING AND ADHESIVE TECHNOLOGY (28 Entries)

2	4	5	7	14	17	20	23	32	33
34	44	59	60	66	67	80	81	91	96
101	106	134	143	146	163	165	166		

MATERIALS DURABILITY AND STRUCTURAL INTEGRITY (48 Entries)

3	6	8	9	12	18	19	21	22	24
25	28	30	31	32	44	56	61	64	68
80	85	89	90	94	95	100	107	112	114
117	120	121	123	124	126	129	130	131	132
141	143	144	145	152	157	167	169		

NUCLEAR, BIOLOGICAL, CHEMICAL TESTING (19 Entries)

SENSORS, OPTICS, AND MEASUREMENT TECHNOLOGY (35 Entries)

ENERGETICS AND MUNITIONS TESTING (20 Entries)

OTHER ARMY TESTING PROBLEMS (30 Entries)

APPENDIX C.7

SUBMISSIONS INDEX BY TEST TECHNOLOGY CATEGORY

SUBMISSIONS INDEX BY TEST TECHNOLOGY CATEGORY

MECHANICAL TESTING (77 Entries)

3	6	7	11	15	21	25	26	27	28
29	30	31	32	39	41	42	44	45	54
55	56	58	61	62	64	69	70	71	72
73	74	80	89	90	91	92	93	94	95
96	97	98	99	102	103	108	111	112	114
115	116	117	118	119	120	121	123	124	126
127	128	129	130	131	132	134	136	140	141
144	145	146	152	156	157	158			

CHEMICAL TESTING (47 Entries)

4	8	9	10	12	13	17	19	40	41
42	43	45	46	47	48	49	50	51	52
53	54	63	65	66	67	68	77	79	82
91	111	115	118	123	124	125	130	135	137
138	144	145	146	159	160	172			

NONDESTRUCTIVE TESTING (102 Entries)

1	2	3	4	5	6	7	8	9	10
12	13	14	16	17	18	19	20	21	22
23	24	25	26	27	31	32	34	37	44
48	53	55	56	57	58	59	60	61	62
64	65	66	67	68	69	70	71	75	76
78	81	83	84	85	86	87	88	91	92
93	94	95	96	99	100	101	104	105	106
107	109	110	113	122	126	127	128	129	131
132	134	139	141	142	143	147	148	153	154
159	161	162	163	164	165	166	167	168	169
170	171								

ELECTRONICS/SOFTWARE TESTING (42 Entries)

11	15	18	23	29	33	35	36	38	39
40	57	72	84	85	88	90	91	97	98
100	103	104	105	123	124	133	140	147	148
149	150	151	152	153	154	155	162	170	172
173	174								

OTHER TESTING TECHNOLOGIES (5 Entries)

29	136	140	145	164

APPENDIX C.8

SUMMARY TABLE OF ALL TESTING NEED CATEGORIES AND SUBMISSIONS FORM NUMBERS

SUMMARY TABLE OF ALL TESTING NEED CATEGORIES
AND SUBMISSIONS FORM NUMBERS

	TEST TECHNOLOGY					PRODUCT CATEGORY						PROBLEM AREAS								
*TNS#	MECH	CHEM	NDT	ELES	OTH	AMW	VEH	AIR	MIS	PER	ELS	MAT	AIP	DIA	BND	DUR	NBC	SOM	ENR	OTH
1	-	-	X	-	-	-	-	X	-	-	-	X	-	X	-	-	-	-	-	-
2	-	-	X	-	-	-	-	X	-	-	-	X	-	X	X	-	-	-	-	-
3	X	-	X	-	-	-	-	X	-	-	-	X	-	X	-	X	-	-	-	-
4	-	X	X	-	-	-	X	X	-	-	-	X	X	-	X	-	-	-	-	-
5	-	-	X	-	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-
6	X	-	X	-	-	-	X	X	-	-	-	X	-	X	-	X	-	-	-	-
7	X	-	X	-	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-
8	-	X	X	-	-	-	-	X	-	-	-	-	-	X	-	X	-	-	-	-
9	-	X	X	-	-	-	-	X	-	-	-	X	-	X	-	X	-	-	-	-
10	-	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	X
11	X	-	-	X	-	X	-	X	X	X	-	-	-	-	-	-	-	X	-	X
12	-	X	X	-	-	-	X	X	-	-	-	-	-	X	-	X	-	-	-	-
13	-	X	X	-	-	-	X	X	-	-	-	X	-	X	-	-	-	X	-	-
14	-	-	X	-	-	-	X	X	-	-	-	-	X	-	X	-	-	X	-	-
15	X	-	-	X	-	-	X	-	-	-	-	-	X	-	-	-	-	X	-	-
16	-	-	X	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	X	-
17	-	X	X	-	-	X	X	-	-	-	-	-	X	-	X	-	-	X	-	-
18	-	-	X	X	-	X	-	-	-	-	-	-	X	-	-	X	-	X	-	-
19	-	X	X	-	-	-	X	-	-	-	-	X	-	X	-	X	-	-	-	-
20	-	-	X	-	-	-	-	X	X	-	-	-	-	X	X	-	-	-	-	-
21	X	-	X	-	-	X	-	X	-	-	-	X	-	-	-	X	-	-	-	-
22	-	-	X	-	-	-	X	X	-	-	-	X	-	X	-	X	-	-	-	-
23	-	-	X	X	-	-	X	-	-	-	-	-	X	-	X	-	-	X	-	-
24	-	-	X	-	-	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-
25	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-
26	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-
27	X	-	X	-	-	-	-	-	X	-	X	-	-	-	-	-	-	X	-	-
28	X	-	-	-	-	X	-	-	X	-	X	-	-	-	-	X	-	-	-	-
29	X	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	X
30	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-
31	X	-	X	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X	X	-
32	X	-	X	-	-	-	-	-	-	-	X	-	-	X	X	X	-	-	-	-
33	-	-	-	X	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	X
34	-	-	X	-	-	-	-	-	-	-	X	-	X	X	X	-	-	-	-	-
35	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
36	-	-	-	X	-	X	-	-	X	-	X	-	X	-	-	-	-	-	-	X
37	-	-	X	-	-	-	X	-	-	-	-	X	-	X	-	-	-	-	-	-
38	-	-	-	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	X
39	X	-	-	X	-	X	-	-	X	-	X	-	-	-	-	-	-	X	-	-
40	-	X	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	X
41	X	X	-	-	-	-	-	-	-	X	-	X	-	X	-	-	X	-	-	-
42	X	X	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	X	X	-
43	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-
44	X	-	X			-	-	-	-	X	-	X	-	X	X	X	-	-	-	-
45	X	X	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X	-	X
46	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	X	-	-
47	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-
48	-	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-	X	X	-	-
49	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	X
50	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	X
51	-	X	-	-	-	X	-	-	-	X	-	X	-	-	-	-	X	-	-	-
52	-	X	-	-	-	-	-	-	-	X	-	X	-	-	-	-	X	-	-	-
53	-	X	X	-	-	-	-	-	-	X	-	-	X	-	-	-	X	-	-	-

*See page C.8-4 for legend.

SUMMARY TABLE OF ALL TESTING NEED CATEGORIES
AND SUBMISSIONS FORM NUMBERS (CONT'D)

TNS#	TEST TECHNOLOGY					PRODUCT CATEGORY						PROBLEM AREAS								
	MECH	CHEM	NDT	ELES	OTH	AMW	VEH	AIR	MIS	PER	ELS	MAT	AIP	DIA	BND	DUR	NBC	SOM	ENR	OTH
54	X	X	-	-	-	X	-	-	-	X	-	X	-	-	-	-	-	-	X	X
55	X	-	X	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-	-	-
56	X	-	X	-	-	X	-	-	-	-	-	-	X	X	-	X	-	-	-	-
57	-	-	X	X	-	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-
58	X	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-
59	-	-	X	-	-	-	X	-	-	-	-	-	X	X	X	-	-	-	-	-
60	-	-	X	-	-	-	-	-	X	-	X	-	X	X	X	-	-	-	-	
61	X	-	X	-	-	-	X	-	-	X	-	-	X	X	-	X	-	X	-	-
62	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-
63	-	X	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-
64	X	-	X	-	-	-	X	X	-	X	-	-	-	X	-	X	-	-	-	-
65	-	X	X	-	-	-	X	-	-	X	-	X	-	-	-	-	-	X	-	-
66	-	X	X	-	-	-	X	X	-	X	-	X	X	X	X	-	-	-		
67	-	X	X	-	-	-	X	X	-	X	-	X	-	X	X	-	-			
68	-	X	X	-	-	-	X	X	-	-	-	X	-	X	-	X	-	-		
69	X	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X		
70	X	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X	-	-
71	X	-	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-	X	-	-
72	X	-	-	X	-	X	-	-	-	-	-	-	X	X	-	-	-		-	-
73	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	
74	X	-	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-		
75	-	-	X	-	-	X	-	-	-	-	-	-	X	X	-	-	-	-		-
76	-	-	X	-	-	X	-	-	-	-	-	X	-	X	-	-	-			
77	-	X	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-		
78	-	-	X	-	-	X	X	X	-	-	-	X	-	X	-	-	-	-	-	
79	-	X	-	-	-	X	-	-	-	-	-	X	-	X	-	-	-			
80	X	-	-	-	-	X	-	-	-	-	-	X	-	-	X	X	-	-	-	-
81	-	-	X	-	-	X	-	-	-	-	-	X	-	X	X	-	-	-		
82	-	X	-	-	-	X	-	-	-	-	-	X	X	X	-	-	-	-	-	
83	-	-	X	-	-	X	-	-	-	-	-	X	-	X	-	-	-			
84	-	-	X	X	-	X	-	-	-	-	-	X	-	X	-	-	-	-		-
85	-	-	X	X	-	X	-	-	-	-	-	X	X	-	-	X	-	X		
86	-	-	X	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	
87	-	-	X	-	-	X	-	-	-	-	-	-	X	-	-	-	-	X		
88	-	-	X	X	-	X	-	-	-	-	-	-	X	X	-	-	-	X	-	
89	X	-	-	-	-	X	-	-	-	-	-	X	X	-	-	X	-		-	
90	X	-	-	X	-	X	-	-	-	-	-	-	-	-	-	X	-			
91	X	X	X	X	-	X	X	X	-	X	-	-	X	-	X	-				
92	X	-	X	-	-	-	X	-	-	-	-	X	X	-	-	-	-		-	
93	X	-	X	-	-	X	X	-	-	-	-	X	-	X	-	-	-			
94	X	-	X	-	-	X	X	-	-	-	-	X	-	-	-	-	-			
95	X	-	X	-	-	X	X	-	-	-	-	X	-	-	-	X	-	-	-	
96	X	-	X	-	-	-	X	-	-	X	-	X	-	X	X	-	-	-	-	-
97	X	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-			
98	X	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-			
99	X	-	X	-	-	X	X	-	-	-	-	X	X	X	-	-	-	-		
100	-	-	X	X	-	-	X	X	-	-	-	X	X	X	-	X	-	-		
101	-	-	X	-	-	-	-	X	-	-	-	X	-	X	X	-	-	-	-	-
102	X	-	-	-	-	-	X	X	-	-	-	X	-	X	-	-	-	-	-	-
103	X	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	X	X
104	-	-	X	X	-	X	X	X	X	-	-	X	-	X	-	-	-			
105	-	-	X	X	-	X	X	X	-	-	-	X	X	X	-	-	-			
106	-	-	X	-	-	-	X	X	-	-	-	X	X	X	X	-	-	-		
107	-	-	X	-	-	-	X	X	-	-	-	X	X	X	-	X	-	-	-	
108	X	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-		
109	-	-	X	-	-	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-

SUMMARY TABLE OF ALL TESTING NEED CATEGORIES
AND SUBMISSIONS FORM NUMBERS (CONT'D)

	TEST TECHNOLOGY					PRODUCT CATEGORY						PROBLEM AREAS								
TNS#	MECH	CHEM	NDT	ELES	OTH	AMW	VEH	AIR	MIS	PER	ELS	MAT	AIP	DIA	BND	SUR	NBC	SOM	ENR	OTH
110	–	–	X	–	–	–	–	–	–	X	–	X	–	–	–	–	–	–	X	X
111	X	X	–	–	–	–	–	–	–	X	–	X	–	–	–	–	X	–	–	–
112	X	–	–	–	–	–	–	–	–	X	–	X	–	–	–	X	–	–	–	–
113	–	–	X	–	–	–	–	–	–	X	–	X	X	–	–	–	–	X	–	–
114	X	–	–	–	–	–	–	–	–	X	–	–	–	–	–	X	–	–	–	X
115	X	X	–	–	–	–	–	–	–	X	–	–	X	–	–	–	X	–	–	–
116	X	–	–	–	–	–	–	–	–	X	–	–	X	–	–	–	X	–	–	–
117	X	–	–	–	–	–	–	–	–	X	–	–	X	–	–	X	–	–	–	
118	X	X	–	–	–	–	–	–	–	X	–	–	X	–	–	–	X	–	–	–
119	X	–	–	–	–	–	–	–	–	X	–	X	–	–	–	–	–	–	X	–
120	X	–	–	–	–	–	–	–	–	X	–	–	–	X	–	X	X	–	–	–
121	X	–	–	–	–	–	–	–	–	X	–	–	–	–	–	X	–	–	–	–
122	–	–	X	–	–	–	–	–	–	X	–	–	X	–	–	–	–	–	–	X
123	X	X	–	X	–	–	–	–	–	X	–	–	–	–	–	X	–	–	–	–
124	X	X	–	X	–	–	–	–	–	X	–	–	–	–	–	X	–	–	–	–
125	–	X	–	–	–	–	–	–	–	X	–	–	X	–	–	–	X	–	–	–
126	X	–	X	–	–	–	–	–	–	X	–	–	–	X	–	X	–	–	–	–
127	X	–	X	–	–	–	–	–	–	X	–	–	X	X	–	–	–	–	–	–
128	X	–	X	–	–	–	–	–	–	X	–	–	–	X	–	–	–	–		
129	X	–	X	–	–	–	–	–	–	X	–	X	–	–	–	X	–	–	–	–
130	X	X	–	–	–	–	–	–	–	X	–	X	–	–	–	X	–	–	–	–
131	X	–	X	–	–	–	–	–	–	X	–	X	–	–	–	X	–	–	–	–
132	X	–	X	–	–	–	–	–	–	X	–	X	–	X	–	X	–	–	–	–
133	–	–	–	X	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	X
134	X	–	X	–	–	–	–	–	–	X	–	X	–	X	X	–	–	–	–	–
135	–	X	–	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–
136	X	–	–	–	X	–	–	–	–	X	–	X	–	–	–	–	–	–	X	
137	–	X	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	X	
138	–	X	–	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–
139	–	–	X	–	–	X	–	–	–	–	–	–	X	–	–	–	–	X	X	–
140	X	–	–	X	X	–	X	–	–	–	–	–	X	X	–	–	–	–	–	
141	X	–	X	–	–	–	X	–	–	–	–	X	–	–	–	X	–	–		
142	–	–	X	–	–	–	X	–	–	–	–	–	X	X	–	–	–	–	–	
143	–	–	X	–	–	–	X	–	–	–	–	X	X	X	X	X				
144	X	X	–	–	–	–	X	–	–	–	–	X	–	X	–	X	–	–	–	–
145	X	X	–	–	X	–	X	–	–	–	–	X	–	–	–	X	–	–	–	–
146	X	X	–	–	–	–	X	X	–	–	–	X	–	–	X	–	–	–	–	–
147	–	–	X	X	–	–	–	–	–	–	X	X	–	X	–	–	–	–	–	–
148	–	–	X	X	–	–	–	–	–	–	X	X	X	X	–	–	–	X	–	–
149	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	X
150	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	
151	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	X
152	X	–	–	X	–	–	–	–	–	–	X	–	–	–	–	X	–	–	–	X
153	–	–	X	X	–	–	–	–	–	–	X	–	X	X	–	–	–	–	–	–
154	–	–	X	X	–	–	–	–	–	–	X	–	X	–	–	–	–	X	–	–
155	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	X
156	X	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	X	–
157	X	–	–	–	–	X	–	–	–	–	–	X	–	–	–	X	–	–	–	–
158	X	–	–	–	–	X	–	–	–	–	–	–	–	X	–	–	–	–	X	–
159	–	X	X	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	X	–
160	–	X	–	–	–	X	–	–	–	–	–	–	–	X	–	–	–	–	X	–
161	–	–	X	–	–	X	–	–	–	–	–	X	–	X	–	–	–	–		
162	–	–	X	X	–	X	–	–	–	–	–	–	X	X	–	–	–	–	–	–
163	–	–	X	–	–	X	–	–	–	–	–	–	–	X	X	–	–		–	
164	–	–	X	–	X	X	–	–	–	–	–	–	X	–	–	–	–	X	X	

SUMMARY TABLE OF ALL TESTING NEED CATEGORIES
AND SUBMISSIONS FORM NUMBERS (CONT'D)

	TEST TECHNOLOGY					PRODUCT CATEGORY						PROBLEM AREAS								
TNS#	MECH	CHEM	NDT	ELES	OTH	AMW	VEH	AIR	MIS	PER	ELS	MAT	AIP	DIA	BND	DUR	NBC	SOM	ENR	OTH
165	-	-	X	-	-	X	-	-	-	-	-	X	X	X	X	-	-	-	-	-
166	-	-	X	-	-	X	-	-	-	-	X	-	X	X	X	-	-	-	-	
167	-	-	X	-	-	X	-	X	-	-	-	X	-	X	-	X		-	-	-
168	-	-	X	-	-	X	-	-	-	-	-	-	X	X	-	-	-	-	X	-
169	-	-	X	-	-	X	X	X	-	-	-	X	-	X	-	X	-	-	-	-
170	-	-	X	X	-	X	-	-	-	-	-	-	X	-	-	-	-	X	-	-
171	-	-	X	-	-	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-
172	-	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X
173	-	-	-	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	X	-
174	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-

	TEST TECHNOLOGY					PRODUCT CATEGORY						PROBLEM AREAS								
TOTALS	MECH	CHEM	NDT	ELES	OTH	AMW	VEH	AIR	MIS	PER	ELS	MAT	AIP	DIA	BND	DUR	NBC	SOM	ENR	OTH
174	77	47	10242		5	69	47	33	9	56	22	82	58	77	28	48	19	35	20	30
%	44	27	59	24	3	40	27	19	6	32	13	47	33	44	16	28	11	20	11	17

APPENDIX C.8 LEGEND

TNS# - Survey Submission Form Number

Test Technology:

MECH - Mechanical Testing Technology
CHEM - Chemical Testing Technology
NDT - Nondestructive Testing Technology
ELES - Electronic and Software Testing Technology
OTH - Other Identified Testing Technology

Product Category:

AMW - Ammunition and Weapons
VEH - Vehicles, Tracked Combat and Tactical Support
AIR - Aircraft, Components and Related Equipment
MIS - Missiles, Components and Related Equipment
PER - Personnel Items and Support Equipment
ELS - Electronic Equipment and Software Support

Problem Areas:

MAT - Materials Characterization and Properties
AIP - Automated Testing and In-Process Control
DIA - Diagnostic Testing and Assessment
BND - Bonding and Adhesive Joining Technology
DUR - Materials Durability and Structural Integrity
NBC - Nuclear, Biological, and Chemical Testing
SOM - Sensors, Optics, and Measurement Technology
ENR - Energetics and Munitions Testing
OTH - Other Army Testing Problem Areas

APPENDIX D

TESTING NEEDS KEYWORD INDEX

APPENDIX D - TABLE OF CONTENTS

APPENDIX D.1

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS

* KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
1	1	ABSORBANT	51
2	5	ABSORPTION	52 54 99 119 122
3	1	ACCELERATED	112
4	1	ACCEPTABILITY	137
5	2	ACCEPTANCE	161 174
6	1	ACOUSTIC EMISSION	55
7	2	ACOUSTO-ULTRASONICS	76 143
8	2	ACQUISITION	36 39
9	1	ACRYLICS	44
10	3	ADHESION	66 80 81
11	3	ADHESIVE BONDS	5 20 41
12	8	ADHESIVES	2 63 67 96 101 106 143 163
13	1	ADSORPTION	111
14	2	AEROSOL	53 135
15	2	AGING	44 131
16	1	AIR	125
17	1	AIR DROP	130
18	1	AIR GUNS	30
19	21	AIRCRAFT	1 2 3 4 5 7 8 9 12 13 14 17 20 52 54 64 68 100 101 107 114
20	2	AIRFOILS	100 107
21	3	AIRFRAME	8 12 21
22	1	ALTERNATIVES	146
23	1	ALTITUDE TESTING	114
24	1	AMBIENT	124
25	6	AMMUNITION	156 157 158 161 163 164 159
26	1	ANALYSIS	136
27	1	ANTHROPOLOGICAL	173
28	1	ANTI TANK	1
29	1	APACHE	162
30	1	ARCHIVED	29 31 58 92 95 97 98 103 110
31	9	ARMOR	148
32	1	ARRAYS	35 36 109 149 170 158
33	5	ARTIFICIAL INTEL	68
34	1	ARTILLERY	15 153 84
35	1	ASSESSMENT	18 34 53 55 56 57 59 60 61 74 77 83 127 134 143 153 170 171 167
36	2	ATE	29 30 31 58 103 110 35 72
37	1	AUTOFRETTAGE	64 93 95 136
38	18	AUTOMATED	
39	1	BACKSCATTER	
40	6	BALLISTICS	
41	1	BALLOTING EFFECT	
42	1	BASE PLATES	
43	3	BEARINGS	
44	1	BEHAVIORAL	

*See page D.1-12 for legend.

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
45	1	BILLETS	83
46	1	BIODEGRADATION	123
47	1	BLACKHAWK	1
48	1	BLADDER TANKS	7
49	1	BLADES	107
50	1	BLISTERING	7
51	1	BODY ARMOR	119
52	1	BOLTS	22
53	5	BONDS	2 67 101 106 143
54	2	BORE	69 88
55	1	BREACH SEAL	72
56	1	BREECHES	90
57	1	BURN RATE	172
58	1	BURN TESTING	172
59	1	BURNING	164
60	1	BUTYL COAT	47
61	1	BY-PRODUCTS	138
62	2	CADMIUM	4 146
63	2	CALORIMETRY	79 160
64	1	CAMOUFLAGE	109
65	1	CANNONS	69
66	1	CANS	128
67	1	CARTRIDGE	163
68	1	CASE	149
69	3	CCCI	149 151 155
70	10	CERAMICS	2 89 92 93 97 98 99 102 104 105
71	1	CHALLENGE	115
72	2	CHAMBER	126 145
73	2	CHARACTERIZATION	88 99
74	1	CHARCOAL	48
75	1	CHARPY	74
76	4	CHEMICAL	13 40 138 159
77	9	CHEMICAL AGENTS	41 43 46 47 48 49 50 52 111
78	2	CHEMICAL MONITOR	4 77
79	12	CHEMICAL TESTING	8 9 10 12 17 19 49 51 63 65 79 146
80	1	CHEMISTRY	82
81	1	CHILLED	124
82	1	CHROMATOGRAPHY	111
83	4	CHROMIUM	4 66 80 81
84	3	CIRCUIT BOARDS	34 62 166
85	1	CLOSED BOMB	172
86	15	CLOTHING	47 109 111 112 113 115 116 117 118 120 121 122 135 136 138
87	5	COATINGS	52 62 63 80 81
88	1	COLOR	46
89	1	COLOR QUALITY	174

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS						
90	1	COMBAT	59						
91	1	COMBUSTION PRODUCTS	125						
92	1	COMPATIBILITY	160						
93	4	COMPONENTS	3	13	57	145			
94	21	COMPOSITES	1	2	20	37	41	67	76
			78	79	89	96	102	104	105
			106	108	134	157	161	165	167
95	1	COMPOSITION	159						
96	2	COMPRESSOR	120	140					
97	4	COMPUTER	29	33	35	36			
98	2	COMPUTER MODELING	97	98					
99	3	COMPUTERIZED	75	89	139				
100	1	CONDITION	126						
101	1	CONFORMAL	62						
102	1	CONFORMANCE TESTING	136						
103	1	CONSTRUCTION MATERIA	134						
104	1	CONSUMPTION	137						
105	2	CONTAINER	123	130					
106	3	CONTAMINATION	41	43	116				
107	1	CONTINUOUS MEASUREME	31						
108	6	CONTROL	23	61	82	85	86	87	
109	1	COOLING	120						
110	1	COORDINATE MEASURING	70						
111	1	CORDAGE	131						
112	10	CORROSION	8	12	18	24	56	68	94
			100	107	145				
113	1	COUNTERMEASURES	113						
114	1	COVERAGE	42						
115	1	CRACKING	22						
116	1	CURE	165						
117	1	CURING	79						
118	1	CUTTING TOOL	85						
119	1	CVC	118						
120	5	DAMAGE	16	68	87	98	142		
121	1	DATA	162						
122	1	DATABASE	108						
123	1	DAYLIGHT	112						
124	1	DEBONDING	5						
125	3	DECONTAMINATION	41	43	138				
126	5	DEFECTS	76	78	88	134	148		
127	1	DEFENSE	138						
128	2	DEFORMATION	72	110					
129	4	DEGRADATION	85	123	132	147			
130	1	DELAMINATION	16						
131	1	DENSITY	42						
132	3	DESIGN	33	109	149				
133	1	DESTRUCTIVE	80						
134	12	DETECTION	13	21	24	39	46	68	100
			107	122	126	133	151		
135	2	DETECTOR	46	148					

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS						
136	1	DETERIORATION	44						
137	1	DETONATOR	139						
138	1	DETOXIFICATION	138						
139	3	DEVELOPMENT	94	96	130				
140	2	DEVICE	153	154					
141	1	DEVICES	147						
142	1	DIAGNOSTICS	57						
143	1	DIAMETER	69						
144	1	DIFFUSION	116						
145	1	DIGITIZED	162						
146	1	DIMENSIONAL MEASUREM	15						
147	1	DISPOSAL	10						
148	1	DROPLET SIZE	46						
149	1	DUAL HARDNESS	94						
150	2	DURABILITY	117	141					
151	1	DYNAMIC	129						
152	1	DYNAMIC TESTING	89						
153	1	EFFECTIVENESS TEST	48						
154	4	ELASTOMERS	7	96	141	143			
155	4	ELECTROMAGNETICS	38	40	45	133			
156	1	ELECTROMIGRATION	147						
157	9	ELECTRONICS	27	32	33	34	38	57	60
			62	147					
158	1	EMERGING	104						
159	1	EMI	133						
160	1	ENGINE	140						
161	2	ENGINEERING	149	155					
162	12	ENGINES	3	9	13	15	17	19	20
			64	65	66	68	142		
163	1	ENHANCEMENTS	104						
164	2	ENSEMBLE	115	118					
165	3	ENVIRONMENTAL	44	145	152				
166	5	EQUIPMENT	38	39	52	74	136		
167	1	EQUIVALENCY	117						
168	1	EQUIVALENT MATERIAL	51						
169	1	ERROR	151						
170	1	ESTIMATION	150						
171	3	EVACUATOR	76	78	83				
172	14	EVALUATION	35	90	92	109	111	115	116
			118	119	120	121	122	124	154
173	1	EVENTS	103						
174	2	EXPERT SYSTEMS	35	36					
175	1	EXPLOSIVES	160						
176	2	EXPOSURE	112	138					
177	1	FABRICS	113						
178	6	FAILURE	28	32	67	145	147	150	
179	1	FASTENERS	146						
180	4	FATIGUE	21	102	129	144			
181	1	FEEDING	125						
182	2	FIELD	125	128					

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
183	2	FIELD SAMPLING	43 46
184	1	FIELD TESTING	117
185	1	FIELD USE	137
186	1	FILTERS	48
187	1	FLOOR PANELS	6
188	1	FLOURESCENCE	113
189	1	FORCES	158
190	3	FORGING	74 75 86
191	2	FRAGMENTATION	98 110
192	1	FUEL	7
193	1	FUEL LEAKS	8
194	1	FUEL STORAGE	9
195	2	FUEL TANKS	7 55
196	1	FULLERS EARTH	51
197	3	FUZES	25 26 139
198	1	GAGING	144
199	1	GARMENTS	111
200	1	GAS MASKS	53
201	1	GAS PHASE	53
202	2	GEARS	61 95
203	1	GLASS	6
204	1	GRAPHITE REINFORCED	165
205	1	GRENADES	169
206	1	GRINDING BURN	13
207	1	GROOVES	69
208	1	GRP	165
209	22	GUN TUBES	17 18 21 25 26 56 69 70 71 74 75 77 80 81 83 84 85 86 88 87 93 95
210	1	HAWK MISSILE	60
211	3	HAZARDOUS WASTES	10 49 50
212	1	HEADFORM	53
213	2	HEAT ENGINES	93 120
214	2	HELMETS	110 119
215	1	HIGH ENERGY WEAPONS	30
216	2	HIGH G EVENTS	29 30
217	1	HIGH HARDNESS	94
218	1	HIGH PIN COUNT	153
219	1	HIGH SPEED	153
220	1	HIGH STRAIN	129
221	1	HIGH STRESS	89
222	1	HIGH TOUGHNESS	94
223	1	HISAC	130
224	2	HISTORY	26 27
225	3	HOWITZER	71 72 167
226	1	HYDROGEN DAMAGE	3
227	1	HYDROGEN EMBRITTLE	169
228	1	IDENTIFICATION	36
229	1	IMAGES	162

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
230	4	IMAGING	14 34 60 100
231	1	IMBEDDED	11
232	1	IMCS	120
233	5	IMPACT	29 73 97 103 119
234	1	INCLUSIONS	83
235	1	INDUSTRIAL	75
236	1	INERTNESS	123
237	9	INFRARED	23 39 45 54 85 113 134
			159 164
238	1	INJECTION MOLDING	99
239	1	INORGANICS	101
240	33	INSPECTION	18 34 55 56 59 60 61
			64 70 71 72 73 75 76
			78 84 105 106 107 127 133
			131 132 139 142 143 163 164
			166 167 168 170 171
241	1	INSTRUMENT	48
242	1	INTEGRITY	106
243	1	INTEROPERABILITY	155
244	1	ION IMPLANTATION	91
245	3	JOINTS	2 67 163
246	1	KEYWAYS	71
247	1	KIT	43
248	1	LAMINATES	44
249	1	LAMINOGRAPHY	166
250	1	LAN	155
251	1	LARGE CALIBER	90
252	4	LASER	42 71 88 154
253	2	LASER INTERFEROMETRY	31 58
254	1	LASER MARKING	11
255	1	LAUNCHER	76
256	1	LEAK DETECTION	55
257	1	LEAKAGE	133
258	1	LEARNING	170
259	2	LIFE	144 152
260	1	LIFE-CYCLE	90
261	2	LIGHT SCATTERING	42 53
262	1	LIQUID AGENTS	46
263	2	LOADING	89 90
264	1	LONG TERM	160
265	1	LOW OBSERVABLES	45
266	1	LOW TEMPERATURE	114
267	4	LUBRICANTS	9 19 40 65
268	1	M-6	159
269	1	M14 MASK	53
270	1	M1A1	141
271	1	M42	169
272	1	MACHINE	70
273	1	MACHINE TOOL	87
274	1	MACHINING	85

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
275	1	MAGNETO-OPTICAL	148
276	2	MAINTENANCE	14 151
277	1	MANPRINT	136
278	1	MAPPER	148
279	1	MARKINGS	11
280	1	MASKING MATERIALS	45
281	1	MASKS	48
282	22	MATERIALS	3 22 38 41 47 48 [illegible]
			75 93 96 102 103 104 [illegible]
			110 129 130 136 146 147 [illegible]
			161
283	2	MEAL	127 128
284	7	MEASUREMENT	17 18 24 42 58 [illegible]
285	9	MECHANICAL	3 6 15 32 44 102 [illegible]
			146 157
286	1	MECHANISMS	61
287	7	METALS	2 13 21 [illegible] 97 [illegible] [illegible]
288	2	METHODS	91 104
289	1	MICROCIRCUITS	153
290	7	MICROELECTRONICS	11 32 147 148 152 153 [illegible]
291	3	MICROWAVE	45 152 154
292	4	MILLIMETER WAVE	45 54 152 154
293	1	MINES	173
294	1	MISSILE CARRIERS	23
295	2	MISSILES	20 27
296	1	MITIGATORS	30
297	1	MM WAVE	54
298	1	MODAL TESTING	87
299	5	MODELING	29 33 35 103 117
300	1	MODULE TESTING	140
301	1	MOISTURE	101
302	12	MONITORING	17 19 23 64 65 79 [illegible]
			85 86 105 125 144
303	3	MORTARS	70 73 156
304	2	MOTION	31 58
305	1	MOUNTS	156
306	1	MULTI LAYERED	166
307	1	MULTI-AXIS	28
308	1	MULTIPLE THREAT	118
309	6	MUNITIONS	24 54 168 169 170 171
310	5	NBC	115 116 118 120 135
311	70	NDE	1 2 3 4 5 [illegible]
			8 9 10 12 13 [illegible] [illegible]
			18 19 20 22 23 [illegible] [illegible]
			26 27 31 34 37 44 [illegible]
			56 57 58 59 60 61 [illegible]
			64 65 66 67 68 [illegible] [illegible]
			81 83 84 85 87 88 [illegible]
			92 93 104 105 106 107 [illegible]
			128 131 132 134 142 143 [illegible]

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
311	70	NDE	161 162 163 165 167 168 169
312	1	NETWORK	155
313	1	NEURAL NETWORK	170
314	2	NEUTRALIZATION	49 50
315	4	NEUTRON	99 100 101 169
316	1	NEUTRON ANALYSIS	99
317	2	NON-METALLICS	37 144
318	119	NONE	5 5 6 8 10 11 12 12 12 15 15 21 22 22 24 25 28 28 32 33 43 46 47 47 48 49 49 50 50 50 51 51 51 51 55 55 59 62 63 63 67 69 70 71 74 76 77 77 78 83 84 84 86 86 87 87 88 90 90 92 92 92 93 93 96 97 103 104 105 105 107 108 108 109 109 112 117 117 121 122 123 123 124 126 130 130 132 133 135 135 137 137 138 140 141 144 144 145 145 150 150 151 151 152 156 157 158 159 161 163 164 165 169 170 171 172 173 173 174
319	1	NUTRITION	137
320	2	NYLON	131 132
321	2	OBSCURANTS	42 54
322	1	OBTURATOR	72
323	4	OILS	9 19 40 65
324	1	ON-LINE ANALYSIS	82
325	1	ONE SIDED	167
326	1	OPERATION	150
327	5	OPTICAL	14 25 26 27 61
328	1	OPTICAL ABSORPTION	131
329	1	OPTICAL COATINGS	41
330	1	OPTICAL TESTING	6
331	1	ORGANIC	79
332	1	OVERHAUL	15
333	2	PACKAGING	114 123
334	1	PADS	72
335	2	PAINTS	52 63
336	3	PARACHUTE	121 129 132
337	1	PART IDENTIFICAT	11
338	1	PARTICULATE	135
339	1	PARTS CONTROL	11
340	1	PATRIOT	20
341	1	PATTERNS	109
342	5	PENETRATION	97 98 110 116 135
343	2	PENETRATORS	31 58
344	1	PERFORATION	127

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS						
345	1	PERFORMANCE	155						
346	2	PERMEATION	47	111					
347	1	PHOSPHATE	66						
348	1	PHOTOMETRY	174						
349	3	PLASTICS	6	44	165				
350	10	PLATING	4	17	56	66	77	80	81
			82	91	146				
351	1	PLATING SOLUTION	4						
352	1	PLUNGER	139						
353	4	POLYMERS	79	96	102	119			
354	1	POROSITY	81						
355	2	PORTABLE	133	134					
356	1	POUCH	127						
357	1	POWDERED	95						
358	1	PRESSURE	73						
359	1	PROCEDURES	157						
360	1	PROCESS	23						
361	12	PROCESS CONTROL	4	14	17	66	77	80	81
			92	105	154	159	165		
362	2	PROCESS MONITOR	14	77					
363	1	PRODUCTION SCREENING	28						
364	2	PROGRAMMING	35	36					
365	2	PROJECTILES	25	26					
366	1	PROOF FIRING	73						
367	5	PROPELLANTS	16	159	160	164	172		
368	3	PROPERTIES	108	146	157				
369	9	PROTECTION	47	49	110	111	115	116	117
			122	135					
370	1	PROTECTIVE	118						
371	1	PROTOCOLS	155						
372	1	PUNCTURE	121						
373	2	PYROTECHNICS	160	174					
374	4	QUALITY	64	65	67	125			
375	1	QUALITY ASSURANCE	151						
376	5	QUALITY CONTROL	9	19	22	79	154		
377	1	QUICKNESS	172						
378	1	RADAR	122						
379	5	RADIATION	38	39	40	99	133		
380	8	RADIOGRAPHY	1	16	37	75	100	101	102
			171						
381	1	RAIL GUNS	30						
382	1	RAPID SOLIDIFICATION	95						
383	3	RATIONS	123	124	137				
384	3	REAL TIME	86	168	171				
385	2	RECOIL	71	156					
386	2	RECUPERATORS	140	142					
387	1	REDUCTION	50						
388	2	REFLECTANCE	113	122					
389	3	RELIABILITY	147	150	152				
390	2	REMAINING LIFE	21	57					

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
391	1	REPAIRS	59
392	1	REQUIREMENTS	149
393	1	RESEARCH	94
394	1	RESIDUAL STRESS	84
395	1	RESIDUE	164
396	3	RESISTANCE	52 94 121
397	1	RF SWITCHING	152
398	2	ROADWHEELS	141 143
399	1	ROCKET MOTORS	16
400	1	ROTOR BLADES	5
401	1	ROUGH TERRAIN	121
402	1	RUBBER COMPOUNDS	141
403	2	SADARM	166 171
404	1	SAMPLING	115
405	1	SCATTERING	169
406	2	SEAL	127 128
407	1	SEALANTS	63
408	1	SELF-TESTING	57
409	1	SEMICONDUCTOR	140
410	1	SENSORS	91
411	1	SENSORY CHARACTERIST	137
412	1	SET BACK	158
413	2	SHAKERS	28 32
414	2	SHELF LIFE	63 124
415	4	SHELTERS	125 133 134 136
416	2	SHIELDING	38 99
417	3	SHOCK	26 27 28
418	2	SHOCK EVENTS	27 30
419	1	SHOCK TESTING	30
420	1	SIGNALS	174
421	1	SIGNATURE	45
422	1	SIGNATURES	39
423	2	SIMULANTS	49 115
424	7	SIMULATION	33 35 39 97 98 [illegible] [illegible]
425	3	SIMULATOR	38 73 173
426	1	SLEEPING BAG	114
427	1	SMALL CALIBER	70
428	1	SMOKE	42
429	9	SOFTWARE	29 33 35 36 [illegible] [illegible] [illegible] 151 172
430	1	SOIL	43
431	5	SOLDER JOINTS	32 33 34 60 166
432	1	SOLUTIONS	92
433	1	SPECTRAL DATA	174
434	1	SPECTROMETER	127
435	1	SPECTROPHOTOMETER	113
436	1	SPIN	158
437	1	SPINDLE	72
438	2	STABILITY	124 160
439	1	STAFF	[illegible]

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS
440	5	STANDARDIZATION	108 119 156 157 162
441	1	STANDARDS	161
442	1	STAR GAGES	69
443	1	STATIC	158
444	1	STATION	70
445	3	STEEL	3 89 94
446	1	STINGER	148
447	1	STOCKPILE	168
448	4	STORAGE	7 124 160 168
449	1	STRAIGHTNESS	71
450	1	STRAPPING	131
451	1	STRAPS	129
452	3	STRESS	22 102 152
453	1	STRUCTURAL	95
454	2	STRUCTURES	96 101
455	1	SUBASSEMBLIES	57
456	1	SUBSISTANCE	126
457	1	SUIT	121
458	1	SUPPLY	126
459	1	SUPRS	126
460	1	SURFACE PROCESSING	91
461	1	SURVIVAL KIT	114
462	2	SUSCEPTIBILITY	40 41
463	1	SYSTEM	118
464	1	TAGGING	11
465	5	TANK	140 141 142 163 164
466	3	TARGETS	36 39 45
467	1	TELEMETRY	27
468	1	TEMPERATURE	112
469	1	TENSILE	74
470	1	TENTAGE	129
471	1	TEST CHAMBER	90
472	1	TEST STAND	140
473	14	TESTING	38 42 53 73 102 120 130 145 153 155 156 168 173 174
474	2	TEXTILES	112 132
475	1	THERMAL SHOCK	90
476	3	THERMOGRAPHY	1 37 81
477	2	THICKNESS	62 66
478	1	TITRATION	82
479	4	TOMOGRAPHY	75 106 142 167
480	2	TRACK PADS	20 141
481	1	TRACKED COMBAT	37
482	2	TRACKED VEHICLES	23 24
483	1	TRAILERS	125
484	4	TRANSMISSIONS	15 19 40 64
485	1	TRAY PACKS	128
486	1	TURBINE	140
487	9	ULTRASONICS	1 16 37 70 83 106 134 161 163

ALPHABETIC KEYWORDS LISTING WITH TNS FORM NUMBERS (CONT'D)

KWD#	OCR#	KEYWORD	TNS FORM NUMBERS						
488	1	ULTRAVIOLET	132						
489	1	UNDERWATER	126						
490	2	VACUUM	114	128					
491	1	VAPOR	116						
492	1	VEGITATION	43						
493	7	VEHICLES	20	21	37	52	54	59	63
494	2	VELOCITY	31	58					
495	2	VERIFICATION	149	172					
496	6	VIBRATION	26	27	28	32	87	114	
497	1	VISIBLE	113						
498	4	VISION SYSTEM	18	56	72	139			
499	2	VISUAL	139	170					
500	2	VOIDS	16	83					
501	1	WAM	173						
502	2	WASTE MANAGEMENT	10	50					
503	1	WASTE MONITORING	10						
504	1	WASTE STORAGE	10						
505	1	WATER INTRUSION	5						
506	2	WEAPONS	24	30					
507	8	WEAR	9	18	25	56	91	93	117
			120						
508	1	WEATHERING	112						
509	1	WEBBING	131						
510	3	WELDING	14	23	91				
511	2	WELDS	59	142					
512	1	WIDE AREA	173						
513	1	WINDOW PANELS	6						
514	7	X-RAY	34	60	78	166	167	169	171
515	1	X-RAY DIFFRACTION	84						
516	1	X-RAY FLOURESCENCE	82						

LEGEND:

KWD# - Keyword number
OCR# - Number of occurrences of keyword in survey submissions
Keyword - Testing need keyword descriptor
TNS Form Numbers - Survey submission form numbers in which keyword occurs

APPENDIX D.2

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING

* KWD#	KEYWORD	OCR#	KWD#	KEYWORD	OCR#
318	NONE	119	299	MODELING	5
311	NDE	70	310	NBC	5
240	INSPECTION	33	327	OPTICAL	5
209	GUN TUBES	22	342	PENETRATION	5
282	MATERIALS	22	367	PROPELLANTS	5
19	AIRCRAFT	21	376	QUALITY CONTROL	5
94	COMPOSITES	21	379	RADIATION	5
38	AUTOMATED	18	431	SOLDER JOINTS	5
86	CLOTHING	15	440	STANDARDIZATION	5
172	EVALUATION	14	465	TANK	5
473	TESTING	14	76	CHEMICAL	4
79	CHEMICAL TESTING	12	83	CHROMIUM	4
134	DETECTION	12	93	COMPONENTS	4
162	ENGINES	12	97	COMPUTER	4
302	MONITORING	12	129	DEGRADATION	4
361	PROCESS CONTROL	12	154	ELASTOMERS	4
70	CERAMICS	10	155	ELECTROMAGNETICS	4
112	CORROSION	10	180	FATIGUE	4
350	PLATING	10	230	IMAGING	4
31	ARMOR	9	252	LASER	4
77	CHEMICAL AGENTS	9	267	LUBRICANTS	4
157	ELECTRONICS	9	292	MILLIMETER WAVE	4
237	INFRARED	9	315	NEUTRON	4
285	MECHANICAL	9	323	OILS	4
369	PROTECTION	9	353	POLYMERS	4
429	SOFTWARE	9	374	QUALITY	4
487	ULTRASONICS	9	415	SHELTERS	4
12	ADHESIVES	8	448	STORAGE	4
380	RADIOGRAPHY	8	479	TOMOGRAPHY	4
507	WEAR	8	484	TRANSMISSIONS	4
284	MEASUREMENT	7	498	VISION SYSTEM	4
287	METALS	7	10	ADHESION	3
290	MICROELECTRONICS	7	11	ADHESIVE BONDS	3
424	SIMULATION	7	21	AIRFRAME	3
493	VEHICLES	7	43	BEARINGS	3
514	X-RAY	7	69	CCCI	3
25	AMMUNITION	6	84	CIRCUIT BOARDS	3
40	BALLISTICS	6	99	COMPUTERIZED	3
108	CONTROL	6	106	CONTAMINATION	3
178	FAILURE	6	125	DECONTAMINATION	3
309	MUNITIONS	6	132	DESIGN	3
496	VIBRATION	6	139	DEVELOPMENT	3
2	ABSORPTION	5	165	ENVIRONMENTAL	3
33	ARTIFICIAL INTEL	5	171	EVACUATOR	3
53	BONDS	5	190	FORGING	3
87	COATINGS	5	197	FUZES	3
120	DAMAGE	5	211	HAZARDOUS WASTES	3
126	DEFECTS	5	225	HOWITZER	3
166	EQUIPMENT	5	245	JOINTS	3
233	IMPACT	5	291	MICROWAVE	3

*See page D.2-6 for legend.

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING (CONT'D)

KWD#	KEYWORD	OCR#
303	MORTARS	3
336	PARACHUTE	3
349	PLASTICS	3
368	PROPERTIES	3
383	RATIONS	3
384	REAL TIME	3
389	RELIABILITY	3
396	RESISTANCE	3
417	SHOCK	3
425	SIMULATOR	3
445	STEEL	3
452	STRESS	3
466	TARGETS	3
476	THERMOGRAPHY	3
510	WELDING	3
5	ACCEPTANCE	2
7	ACOUSTO-ULTRASONICS	2
8	ACQUISITION	2
14	AEROSOL	2
15	AGING	2
20	AIRFOILS	2
36	ATE	2
54	BORE	2
62	CADMIUM	2
63	CALORIMETRY	2
72	CHAMBER	2
73	CHARACTERIZATION	2
78	CHEMICAL MONITOR	2
96	COMPRESSOR	2
98	COMPUTER MODELING	2
105	CONTAINER	2
128	DEFORMATION	2
135	DETECTOR	2
140	DEVICE	2
150	DURABILITY	2
161	ENGINEERING	2
164	ENSEMBLE	2
174	EXPERT SYSTEMS	2
176	EXPOSURE	2
182	FIELD	2
183	FIELD SAMPLING	2
191	FRAGMENTATION	2
195	FUEL TANKS	2
202	GEARS	2
213	HEAT ENGINES	2
214	HELMETS	2
216	HIGH G EVENTS	2
224	HISTORY	2
253	LASER INTERFEROMETRY	2
259	LIFE	2
261	LIGHT SCATTERING	2
263	LOADING	2
276	MAINTENANCE	2
283	MEAL	2
288	METHODS	2
295	MISSILES	2
304	MOTION	2
314	NEUTRALIZATION	2
317	NON-METALLICS	2
320	NYLON	2
321	OBSCURANTS	2
333	PACKAGING	2
335	PAINTS	2
343	PENETRATORS	2
346	PERMEATION	2
355	PORTABLE	2
362	PROCESS MONITOR	2
364	PROGRAMMING	2
365	PROJECTILES	2
373	PYROTECHNICS	2
385	RECOIL	2
386	RECUPERATORS	2
388	REFLECTANCE	2
390	REMAINING LIFE	2
398	ROADWHEELS	2
403	SADARM	2
406	SEAL	2
413	SHAKERS	2
414	SHELF LIFE	2
416	SHIELDING	2
418	SHOCK EVENTS	2
423	SIMULANTS	2
438	STABILITY	2
454	STRUCTURES	2
462	SUSCEPTIBILITY	2
474	TEXTILES	2
477	THICKNESS	2
480	TRACK PADS	2
482	TRACKED VEHICLES	2
490	VACUUM	2
494	VELOCITY	2
495	VERIFICATION	2
499	VISUAL	2
500	VOIDS	2
502	WASTE MANAGEMENT	2
506	WEAPONS	2
511	WELDS	2
1	ABSORBANT	1
3	ACCELERATED	1
4	ACCEPTABILITY	1

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING (CONT'D)

KWD#	KEYWORD	OCR#
6	ACOUSTIC EMISSION	1
9	ACRYLICS	1
13	ADSORPTION	1
16	AIR	1
17	AIR DROP	1
18	AIR GUNS	1
22	ALTERNATIVES	1
23	ALTITUDE TESTING	1
24	AMBIENT	1
26	ANALYSIS	1
27	ANTHROPOLOGICAL	1
28	ANTI TANK	1
29	APACHE	1
30	ARCHIVED	1
32	ARRAYS	1
34	ARTILLERY	1
35	ASSESSMENT	1
37	AUTOFRETTAGE	1
39	BACKSCATTER	1
41	BALLOTING EFFECT	1
42	BASE PLATES	1
44	BEHAVIORAL	1
45	BILLETS	1
46	BIODEGRADATION	1
47	BLACKHAWK	1
48	BLADDER TANKS	1
49	BLADES	1
50	BLISTERING	1
51	BODY ARMOR	1
52	BOLTS	1
55	BREACH SEAL	1
56	BREECHES	1
57	BURN RATE	1
58	BURN TESTING	1
59	BURNING	1
60	BUTYL COAT	1
61	BY-PRODUCTS	1
64	CAMOUFLAGE	1
65	CANNONS	1
66	CANS	1
67	CARTRIDGE	1
68	CASE	1
71	CHALLENGE	1
74	CHARCOAL	1
75	CHARPY	1
80	CHEMISTRY	1
81	CHILLED	1
82	CHROMATOGRAPHY	1
85	CLOSED BOMB	1
88	COLOR	1
89	COLOR QUALITY	1
90	COMBAT	1
91	COMBUSTION PRODUCTS	1
92	COMPATIBILITY	1
95	COMPOSITION	1
100	CONDITION	1
101	CONFORMAL	1
102	CONFORMANCE TESTING	1
103	CONSTRUCTION MATERIA	1
104	CONSUMPTION	1
107	CONTINUOUS MEASUREME	1
109	COOLING	1
110	COORDINATE MEASURING	1
111	CORDAGE	1
113	COUNTERMEASURES	1
114	COVERAGE	1
115	CRACKING	1
116	CURE	1
117	CURING	1
118	CUTTING TOOL	1
119	CVC	1
121	DATA	1
122	DATABASE	1
123	DAYLIGHT	1
124	DEBONDING	1
127	DEFENSE	1
130	DELAMINATION	1
131	DENSITY	1
133	DESTRUCTIVE	1
136	DETERIORATION	1
137	DETONATOR	1
138	DETOXIFICATION	1
141	DEVICES	1
142	DIAGNOSTICS	1
143	DIAMETER	1
144	DIFFUSION	1
145	DIGITIZED	1
146	DIMENSIONAL MEASUREM	1
147	DISPOSAL	1
148	DROPLET SIZE	1
149	DUAL HARDNESS	1
151	DYNAMIC	1
152	DYNAMIC TESTING	1
153	EFFECTIVENESS TEST	1
156	ELECTROMIGRATION	1
158	EMERGING	1
159	EMI	1
160	ENGINE	1
163	ENHANCEMENTS	1
167	EQUIVALENCY	1

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING (CONT'D)

KWD#	KEYWORD	OCR#
168	EQUIVALENT MATERIAL	1
169	ERROR	1
170	ESTIMATION	1
173	EVENTS	1
175	EXPLOSIVES	1
177	FABRICS	1
179	FASTENERS	1
181	FEEDING	1
184	FIELD TESTING	1
185	FIELD USE	1
186	FILTERS	1
187	FLOOR PANELS	1
188	FLOURESCENCE	1
189	FORCES	1
192	FUEL	1
193	FUEL LEAKS	1
194	FUEL STORAGE	1
196	FULLERS EARTH	1
198	GAGING	1
199	GARMENTS	1
200	GAS MASKS	1
201	GAS PHASE	1
203	GLASS	1
204	GRAPHITE REINFORCED	1
205	GRENADES	1
206	GRINDING BURN	1
207	GROOVES	1
208	GRP	1
210	HAWK MISSILE	1
212	HEADFORM	1
215	HIGH ENERGY WEAPONS	1
217	HIGH HARDNESS	1
218	HIGH PIN COUNT	1
219	HIGH SPEED	1
220	HIGH STRAIN	1
221	HIGH STRESS	1
222	HIGH TOUGHNESS	1
223	HISAC	1
226	HYDROGEN DAMAGE	1
227	HYDROGEN EMBRITTLE	1
228	IDENTIFICATION	1
229	IMAGES	1
231	IMBEDDED	1
232	IMCS	1
234	INCLUSIONS	1
235	INDUSTRIAL	1
236	INERTNESS	1
238	INJECTION MOLDING	1
239	INORGANICS	1
241	INSTRUMENT	1
242	INTEGRITY	1
243	INTEROPERABILITY	1
244	ION IMPLANTATION	1
246	KEYWAYS	1
247	KIT	1
248	LAMINATES	1
249	LAMINOGRAPHY	1
250	LAN	1
251	LARGE CALIBER	1
254	LASER MARKING	1
255	LAUNCHER	1
256	LEAK DETECTION	1
257	LEAKAGE	1
258	LEARNING	1
260	LIFE-CYCLE	1
262	LIQUID AGENTS	1
264	LONG TERM	1
265	LOW OBSERVABLES	1
266	LOW TEMPERATURE	1
268	M-6	1
269	M14 MASK	1
270	M1A1	1
271	M42	1
272	MACHINE	1
273	MACHINE TOOL	1
274	MACHINING	1
275	MAGNETO-OPTICAL	1
277	MANPRINT	1
278	MAPPER	1
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280	MASKING MATERIALS	1
281	MASKS	1
286	MECHANISMS	1
289	MICROCIRCUITS	1
293	MINES	1
294	MISSILE CARRIERS	1
296	MITIGATORS	1
297	MM WAVE	1
298	MODAL TESTING	1
300	MODULE TESTING	1
301	MOISTURE	1
305	MOUNTS	1
306	MULTI LAYERED	1
307	MULTI-AXIS	1
308	MULTIPLE THREAT	1
312	NETWORK	1
313	NEURAL NETWORK	1
316	NEUTRON ANALYSIS	1
319	NUTRITION	1
322	OBTURATOR	1

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING (CONT'D)

KWD#	KEYWORD	OCR#
324	ON-LINE ANALYSIS	1
325	ONE SIDED	1
326	OPERATION	1
328	OPTICAL ABSORPTION	1
329	OPTICAL COATINGS	1
330	OPTICAL TESTING	1
331	ORGANIC	1
332	OVERHAUL	1
334	PADS	1
337	PART IDENTIFICAT	1
338	PARTICULATE	1
339	PARTS CONTROL	1
340	PATRIOT	1
341	PATTERNS	1
344	PERFORATION	1
345	PERFORMANCE	1
347	PHOSPHATE	1
348	PHOTOMETRY	1
351	PLATING SOLUTION	1
352	PLUNGER	1
354	POROSITY	1
356	POUCH	1
357	POWDERED	1
358	PRESSURE	1
359	PROCEDURES	1
360	PROCESS	1
363	PRODUCTION SCREENING	1
366	PROOF FIRING	1
370	PROTECTIVE	1
371	PROTOCOLS	1
372	PUNCTURE	1
375	QUALITY ASSURANCE	1
377	QUICKNESS	1
378	RADAR	1
381	RAIL GUNS	1
382	RAPID SOLIDIFICATION	1
387	REDUCTION	1
391	REPAIRS	1
392	REQUIREMENTS	1
393	RESEARCH	1
394	RESIDUAL STRESS	1
395	RESIDUE	1
397	RF SWITCHING	1
399	ROCKET MOTORS	1
400	ROTOR BLADES	1
401	ROUGH TERRAIN	1
402	RUBBER COMPOUNDS	1
404	SAMPLING	1
405	SCATTERING	1
407	SEALANTS	1
408	SELF-TESTING	1
409	SEMICONDUCTOR	1
410	SENSORS	1
411	SENSORY CHARACTERIST	1
412	SET BACK	1
419	SHOCK TESTING	1
420	SIGNALS	1
421	SIGNATURE	1
422	SIGNATURES	1
426	SLEEPING BAG	1
427	SMALL CALIBER	1
428	SMOKE	1
430	SOIL	1
432	SOLUTIONS	1
433	SPECTRAL DATA	1
434	SPECTROMETER	1
435	SPECTROPHOTOMETER	1
436	SPIN	1
437	SPINDLE	1
439	STAFF	1
441	STANDARDS	1
442	STAR GAGES	1
443	STATIC	1
444	STATION	1
446	STINGER	1
447	STOCKPILE	1
449	STRAIGHTNESS	1
450	STRAPPING	1
451	STRAPS	1
453	STRUCTURAL	1
455	SUBASSEMBLIES	1
456	SUBSISTANCE	1
457	SUIT	1
458	SUPPLY	1
459	SUPRS	1
460	SURFACE PROCESSING	1
461	SURVIVAL KIT	1
463	SYSTEM	1
464	TAGGING	1
467	TELEMETRY	1
468	TEMPERATURE	1
469	TENSILE	1
470	TENTAGE	1
471	TEST CHAMBER	1
472	TEST STAND	1
475	THERMAL SHOCK	1
478	TITRATION	1
481	TRACKED COMBAT	1
483	TRAILERS	1
485	TRAY PACKS	1

KEYWORD LISTING IN ORDER OF MOST FREQUENTLY OCCURRING (CONT'D)

KWD#	KEYWORD	OCR#	KWD#	KEYWORD	OCR#
486	TURBINE	1			
488	ULTRAVIOLET	1			
489	UNDERWATER	1			
491	VAPOR	1			
492	VEGITATION	1			
497	VISIBLE	1			
501	WAM	1			
503	WASTE MONITORING	1			
504	WASTE STORAGE	1			
505	WATER INTRUSION	1			
508	WEATHERING	1			
509	WEBBING	1			
512	WIDE AREA	1			
513	WINDOW PANELS	1			
515	X-RAY DIFFRACTION	1			
516	X-RAY FLOURESCENCE	1			
0		0			
0		0			
0		0			

LEGEND:

KWD# - Keyword number
Keyword - Testing need keyword descriptor
OCR# - Number of occurrences of keyword in survey submissions

APPENDIX E

SURVEY DATABASE INFORMATION

SURVEY DATABASE INFORMATION

The Testing Needs Survey information collected from individual responses on the Information Summary Forms was condensed and entered into a computer database to assist in analyzing the data. The dBase III Plus program, a product of Ashton-Tate Software, was used to perform the database operations. This software was operated on an IBM-PC compatible computer under the MS-DOS operating system. The program and data were placed on a hard disk drive to allow quick retrieval, sorting, and manipulation of the information.

The survey information was organized into individual RECORDS in the database, each consisting of the following information FIELDS:

Field Name	Type	Width	Description
RECNO	Numeric	4	Record Number in Database
TNSFORM	Numeric	4	Testing Needs Survey Form Number
TITLE	Character	80	Testing Need Title as Presented
PRESENTER	Character	20	Author/Representative of Submission
COMMAND	Character	10	Army Major Subordinate Command
INSTALLAT	Character	12	Installation Submitting Testing Need
COST	Numeric	8	Estimated Cost for Solution in $K
MECH_TECH	Logical	1	Mechanical Test Technology (True/False)
CHEM_TECH	Logical	1	Chemical Test Technology (True/False)
NDT_TECH	Logical	1	Nondestructive Test Technology (True/False)
ELE_SFTWR	Logical	1	Electronic/Software Test Technology (True/False)
OTHER_TECH	Character	12	Specify Other Test Technology (1 word)
KEYWORD1	Character	20	Single word describing a distinct aspect of the subject
...	Character	20	testing need. Up to 8 keywords were allowed for
...	Character	20	each record. Unused keyword fields assigned
KEYWORD8	Character	20	"NONE."
AMW	Logical	1	Ammunition/Weapon Product Category (T/F)
VEH	Logical	1	Vehicles, Combat/Tactical Product Category (T/F)
AIR	Logical	1	Aircraft/Equipment Product Category (T/F)
MIS	Logical	1	Missiles/Equipment Product Category (T/F)
PER	Logical	1	Personnel/Support Product Category (T/F)
ELS	Logical	1	Electronics/Software Product Category (T/F)
MAT	Logical	1	Materials/Properties Problem Area (T/F)
AIP	Logical	1	Automated Testing/In-Process Control (T/F)
DIA	Logical	1	Diagnostic Testing and Assessment (T/F)
BND	Logical	1	Bonding/Adhesive Technology (T/F)
DUR	Logical	1	Durability/Structural Integrity (T/F)
NBC	Logical	1	Nuclear, Biological, Chemical Testing (T/F)
SOM	Logical	1	Sensors, Optics, Measurement Technology (T/F)
ENR	Logical	1	Energetics and Munitions Testing (T/F)
OTH	Logical	1	Other Army Problem Areas

A series of programs were written using the dBASE III Plus commands to manipulate the data, generate database statistics, and print the results.

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Richard Cervantes (Southwest Research Institute, NTIAC)

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